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Skyways

Flight Operations • Engineering • Management

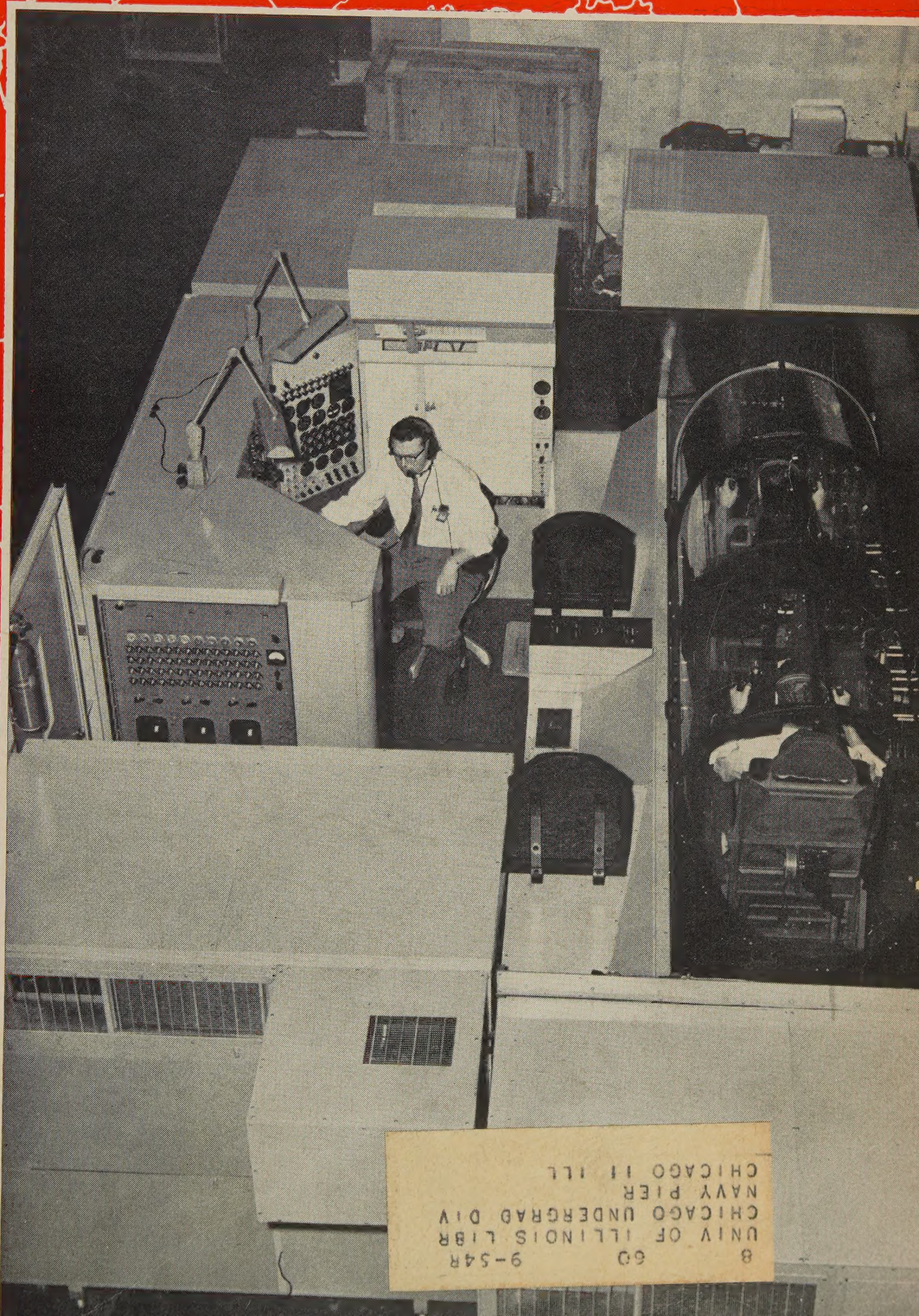

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Table: Human
ring in
craft Industry

1954 50c

On New Orleans Airport It's Magee Aircraft for Service!

Esso

A LARGE WELL-EQUIPPED HANGER and spacious concrete apron are only a part of the facilities of the Magee Aircraft Company, operating at New Orleans Airport.

KEN MENARD AND R. W. MAGEE pose in front of one of the many ships that their company services daily.

"SOME YEARS AGO we foresaw the tremendous potential in the business aircraft industry and streamlined our operation to cater particularly to this phase of aviation. The rapid increase in the use of business aircraft has justified and rewarded our efforts. Looking back, we see that our most important decision was to operate strictly on a high quality basis. The excellent quality of Esso Products and their wide distribution and fine reputation were only a few of the many factors which guided our choice."

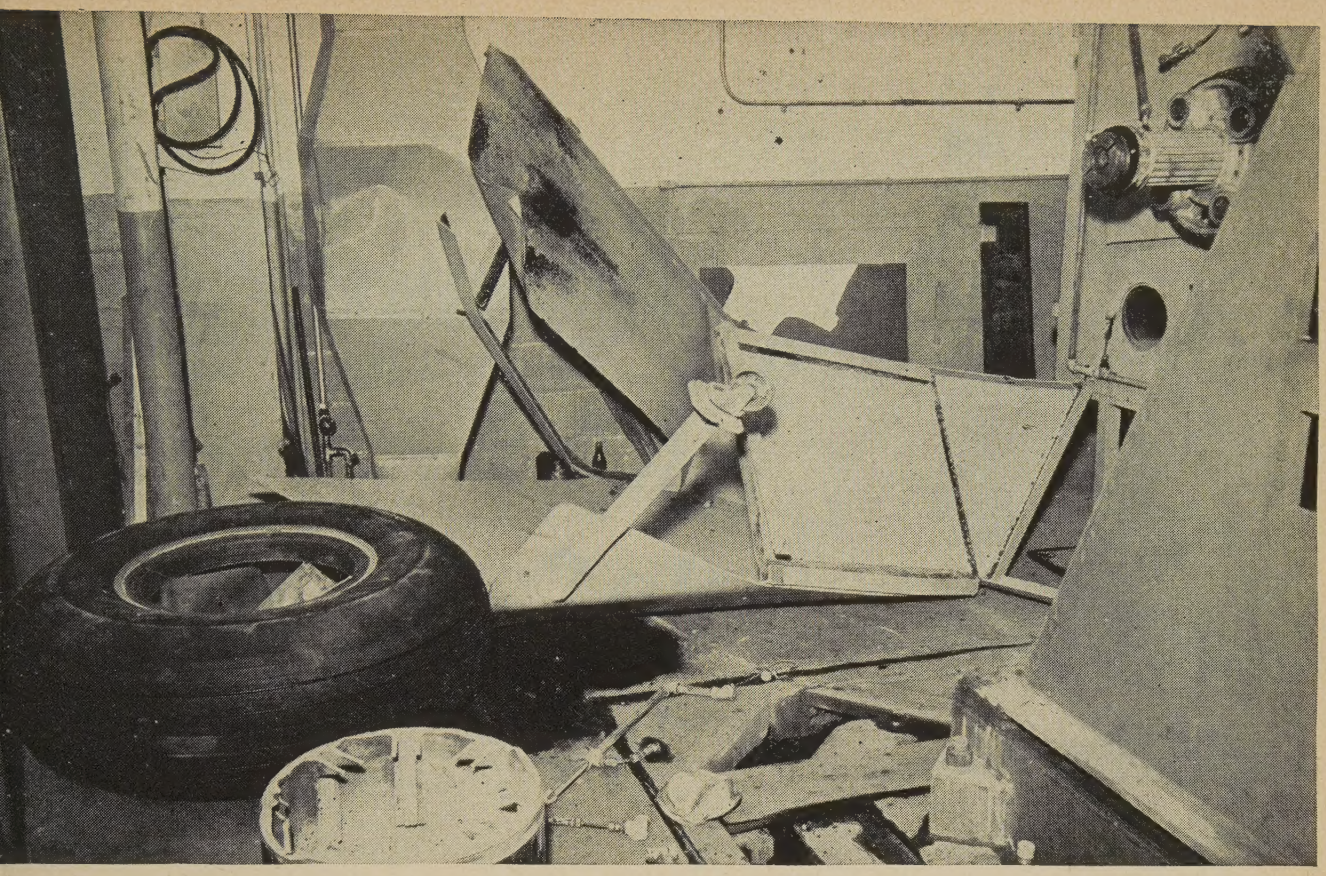
R. W. Magee, President, Magee Aircraft Company, Inc

DEPENDABLE ESSO AVIATION PRODUCTS offer high quality, backed by constant research and development at one of America's largest and finest petroleum laboratories. Flying executives, private plane owners, and commercial airline operators *know* they can depend on the products that carry the famous Esso Oval trade-mark.

Esso

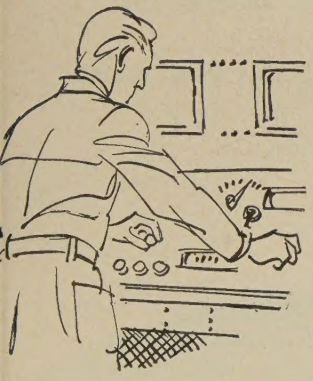
AVIATION PRODUCTS

SOLD IN: Maine, N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Penna., Ohio, Del., Md., D. C., Va., W. Va., Ky., N. C., S. C., Ga., Fla., Ala., Miss., Tenn., Ark., La., Texas.



WE WRECKED THE LABORATORY

—in forcing a failure!



HERE'S the way our Roll Test Room looked after we ran a Goodyear Airplane Wheel — under service load conditions—*far beyond* the life limits demanded by rigid specifications governing the wheel's manufacture.

We ran it hour after hour, mile after mile, day after day — until it literally "exploded"—to find out just where the point of failure would be, once its tough limit of endurance was reached.

By producing such failures, we produce success—for from them we learn more about the characteristics of one of man's oldest and most important inventions . . . the wheel.

As a result—knowing where to shave off metal, where to bolster strength — we are able to build even greater load capacity and life expectancy into each pound of airplane wheel.

Such thorough-going studies — which include the analysis of strain gauge, stress coat, load and burst tests, topped off by rigorous flight testing—have a great deal to do with the superiority of Goodyear Aviation Products.

You might wonder if this tremendous investment in test equipment, engineering talent and research has paid off.

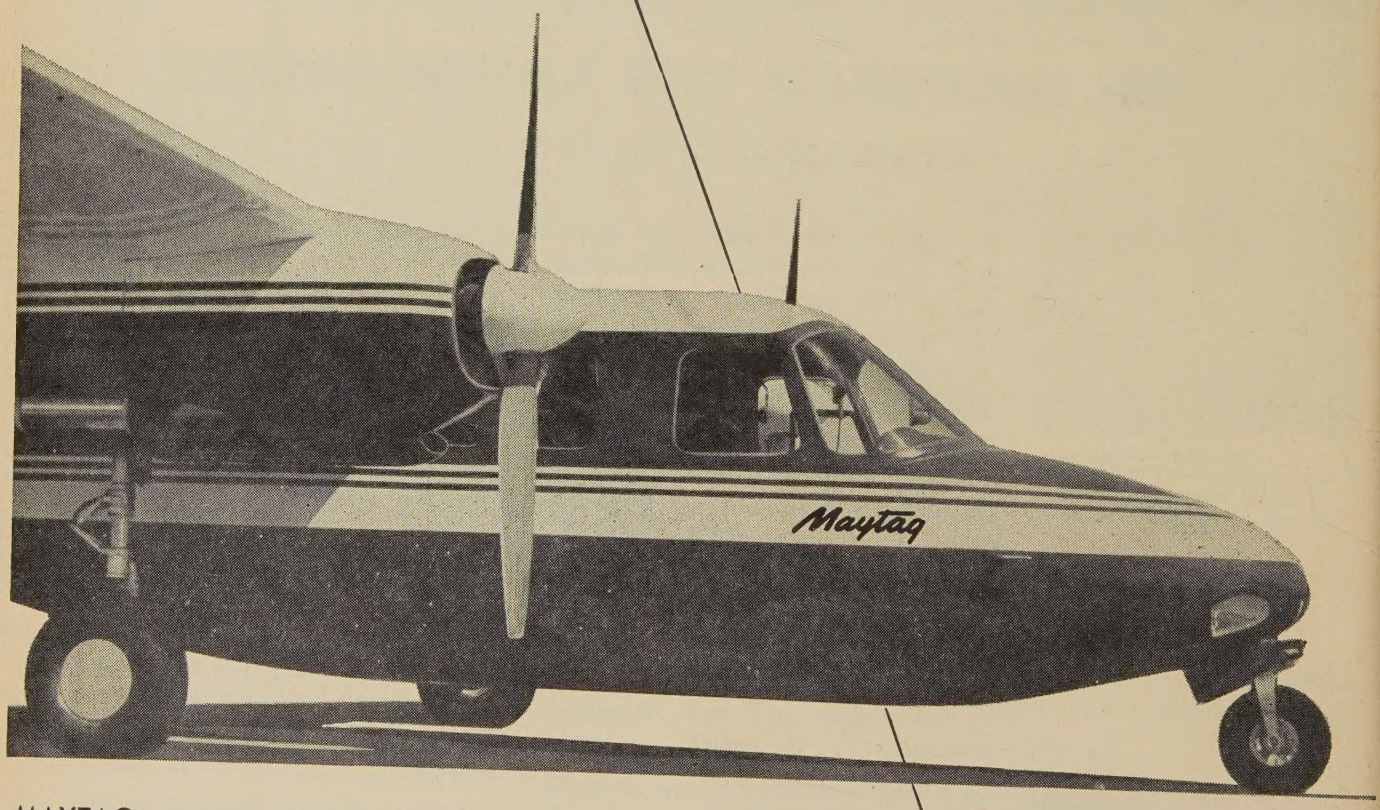
One simple fact gives the answer: *More aircraft land on Goodyear tires, tubes, wheels and brakes than on any other kind.*

Goodyear, Aviation Products Division, Akron 16, Ohio or Los Angeles 54, Calif.

GOODYEAR
AVIATION
PRODUCTS

FACILITIES + ABILITIES = EXTRA *plus* IN PERFORMANCE

a nose for business



MAYTAG—another famous trade-mark on the nose of an Aero Commander. American Industry is finding the five-to-seven-place, twin-engine Aero Commander the perfect executive transport for speeding up and expanding their operations through greater utilization of the time of key personnel.

AERO DESIGN Commander

AERO DESIGN AND ENGINEERING COMPANY
TULAKES AIRPORT P. O. BOX 118 • BETHANY, OKLA

APRIL, 1954

Skyways

Flight Operations • Engineering • Management

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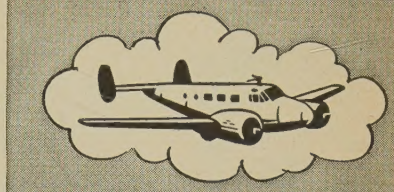
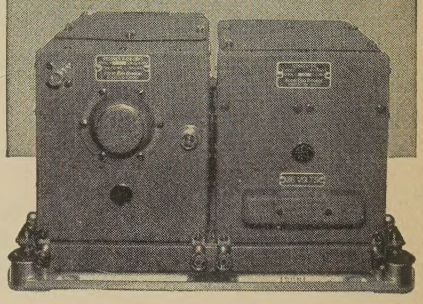
FLY CROSS-COUNTRY



with Ease and Confidence



with ARC OMNI EQUIPMENT

ARC Type 15D VOR Receiving Equipment is four pounds lighter and has one less major unit than previous models. It fills the vital need for static-free communication and navigation facilities, and is ideal for dual omni installations on aircraft where simultaneous reception from two stations is a requisite, and where weight and space must be conserved.

With the 15D you can fly any track on the omni ranges, obtain a precise "fix" on two or more omni stations, make runway localizer approach, and receive weather and other voice signals on the same frequency that localizer or range signals are being received.

Receiver is tunable, covering entire band allocated to above services (108-135 MC).

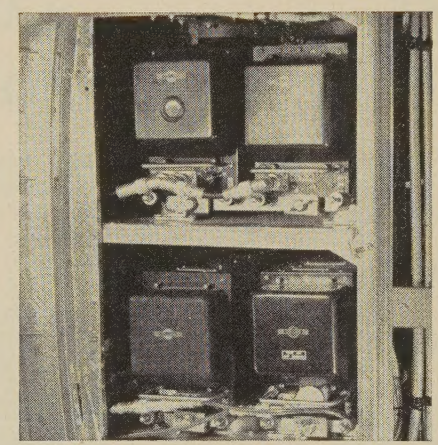
The 15D equipment is sold and installed by ARC dealers, who will be pleased to quote you on a single or dual installation in your aircraft. The price of each 15D is $1,823.00 f.o.b. Boonton, N. J., plus installation charges. Write for technical bulletin and name of your nearest ARC dealer.

Dependable Airborne Electronic Equipment Since 1928

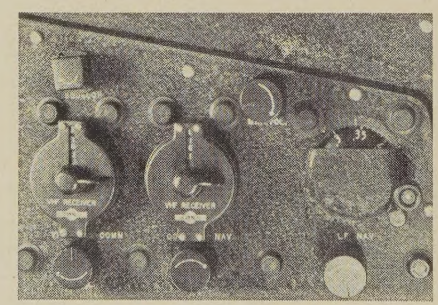
ARC Aircraft Radio Corp

BOONTON, NEW JERSEY

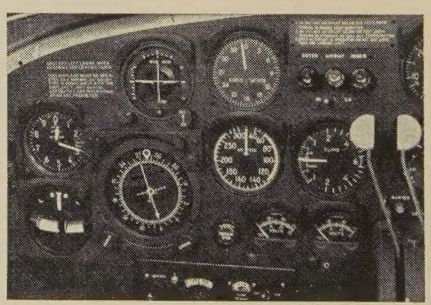
COLLINS flies with the



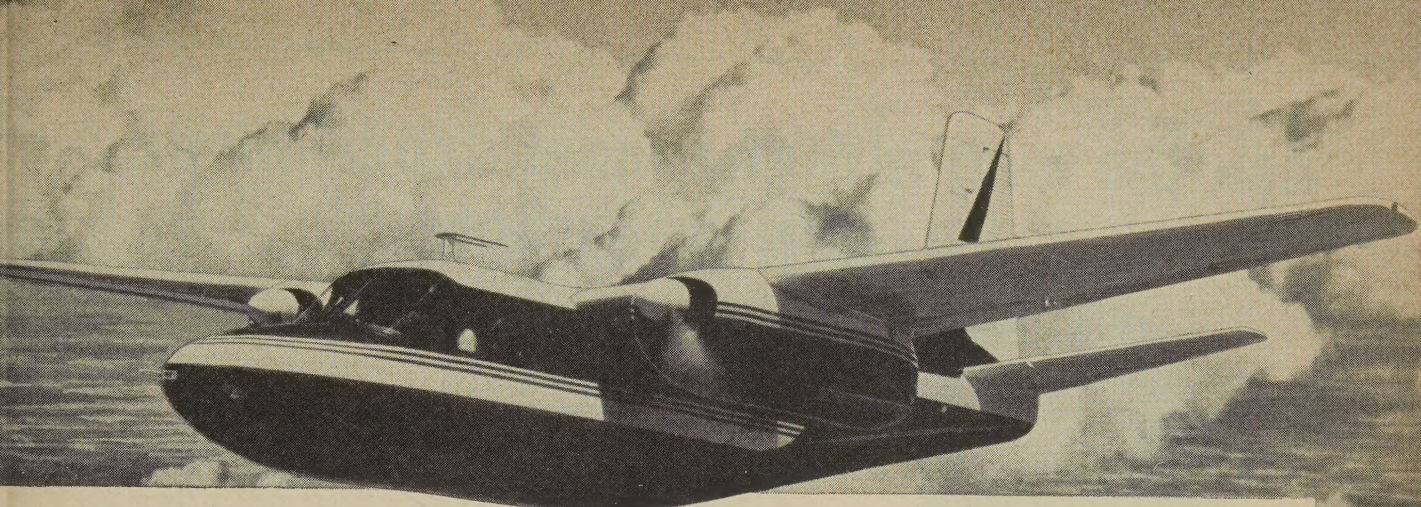
This radio rack in the Aero-Commander shows part of the Collins installation. Top shelf, left to right, holds a Collins 17L-3 VHF Transmitter and 51U Communications Receiver. Bottom shelf holds a Collins 51R-3 Navigation Receiver and 51V Glide Slope Receiver. In addition, this Aero-Commander has a Collins 51Z-1 Marker Beacon Receiver, 18S-4 HF Transmitter-Receiver, 180K-3 Antenna Matching Network, and the Collins Integrated Flight System.



Automatic, finger-tip controls for Collins VHF, HF communication and Collins navigation equipment are conveniently located overhead in Mr. George T. Pew's Aero-Commander. Cockpit and equipment rack design leaves plenty of room for dual VHF Omni and ILS installation.



A section of the Aero-Commander Instrument Panel shows Collins FD-102 Integrated Flight System instruments. The Approach Horizon, top left, and Course Indicator, below left, simplify instrumentation by removal of four conventional instruments, enabling the pilot to make safer ILS approaches.



lero Commanders

Mr. George T. Pew, Chairman of the Board, Aero Design and Engineering Company, equips his Aero-Commander with complete Collins VHF, Omni, ILS and the Integrated Flight System.

The Aero-Commander is one of the most popular executive and private aircraft in use today. Twin 260 HP engines give it a cruising speed of 197 mph and a high speed of 211 mph. Visibility over the nose is unequalled. Landing lights are in the nose for utmost effectiveness and minimum blinding. The three wheels retract swiftly and simultaneously at the flip of a switch. The Aero-Commander seats 5-7 people and has a 32 cu. ft. luggage compartment. Due to its high useful load, the Aero-Commander is ideally suited for Collins airline type communication and navigation equipment. This adds to its utility as an instrument airplane.

No wonder it stands so high with American businessmen. As a pilot *and* engineer, Mr. Pew knows which equipment will give him the most accurate, reliable performance. That's why he installed Collins.

For complete information on Collins communication and navigation equipment, contact the Collins office nearest you. You will receive their prompt attention.

Aero Design and Engineering Company, Bethany, Oklahoma, will factory install Collins equipment when you purchase your Aero Commander. Ask them, or see your nearest Collins authorized aviation dealer.

FIRST in service to the aviation industry . . .

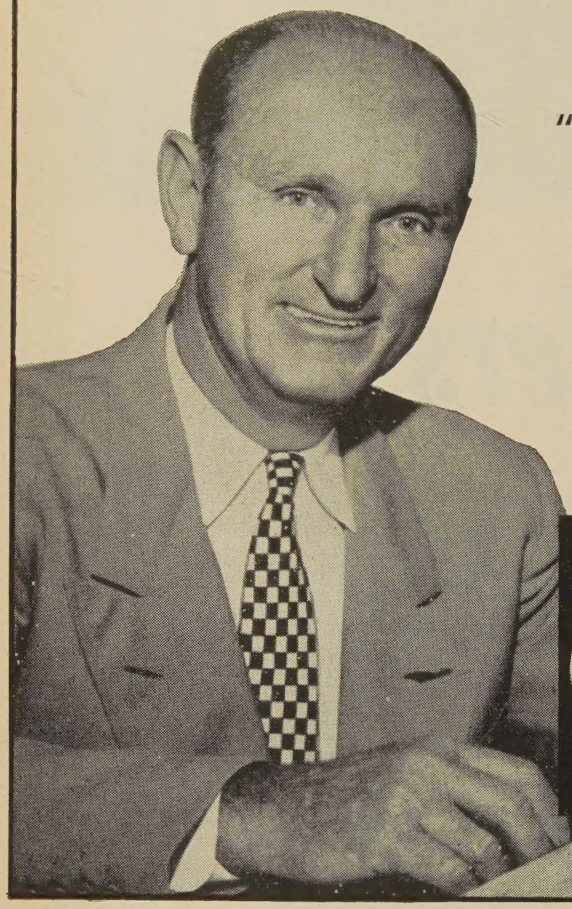
COLLINS RADIO COMPANY
Cedar Rapids, Iowa

11 W. 42nd Street, NEW YORK 36
1930 Hi-Line Drive, DALLAS 2
2700 W. Olive Avenue, BURBANK

COLLINS

Ask the men with the most experience... ask BEN BRANSOM

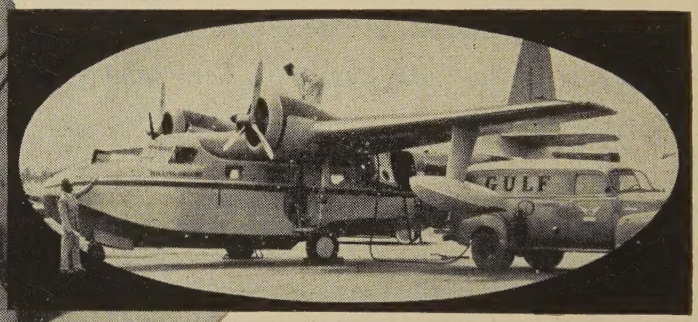
Chief Pilot, Burrus Mills, Inc., Dallas, Texas



"16,000 flight hours teach you a lot," says Ben Bransom, "and they've taught me to depend upon Gulf aviation products. I've flown with Gulf from Alaska to the West Indies, from Canada to Mexico and in every state in the U. S. The consistent high quality of Gulf products has paid off in *better engine performance, lower maintenance costs.*

"That's why my first question upon landing at a strange airport is—'Do you have *Gulf* gas and oil?' "

Chief Pilot Bransom supervises fueling of a Grumman Mallard, latest addition to Burrus Mills' air fleet.



Men who fly a lot—fly with Gulf

Gulf Aircraft Engine Oil, Series-R

For radial engines or where a detergent oil is not desired. Approved by Pratt & Whitney and other radial engine manufacturers for all types of service. Retards sludge and carbon formation and retains its body at high-operating temperatures.

Gulfpride Aviation Oil, Series-D

For horizontally opposed and Ranger in-line engines. Minimizes ring- and valve-sticking, oil consumption, oil-screen clogging and plug-fouling. Users of this great oil have actually increased periods between overhauls as much as 100%.

Gulf Aviation Gasoline

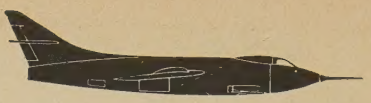
Always "refinery clean" because Gulf Aviation gasoline dispensing equipment is equipped with advanced Micronic Filters.

Gulf Oil Corporation • Gulf Refining Company

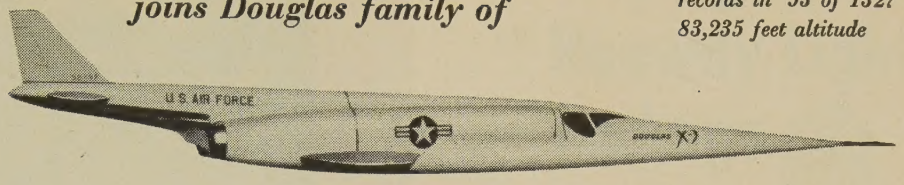
GULF
AVIATION PRODUCTS

Stiletto-shaped twin jet

joins Douglas family of



Skyrocket—set world records in '53 of 1327 mph, 83,235 feet altitude



Skystreak—world speed record 1948, 650 mph

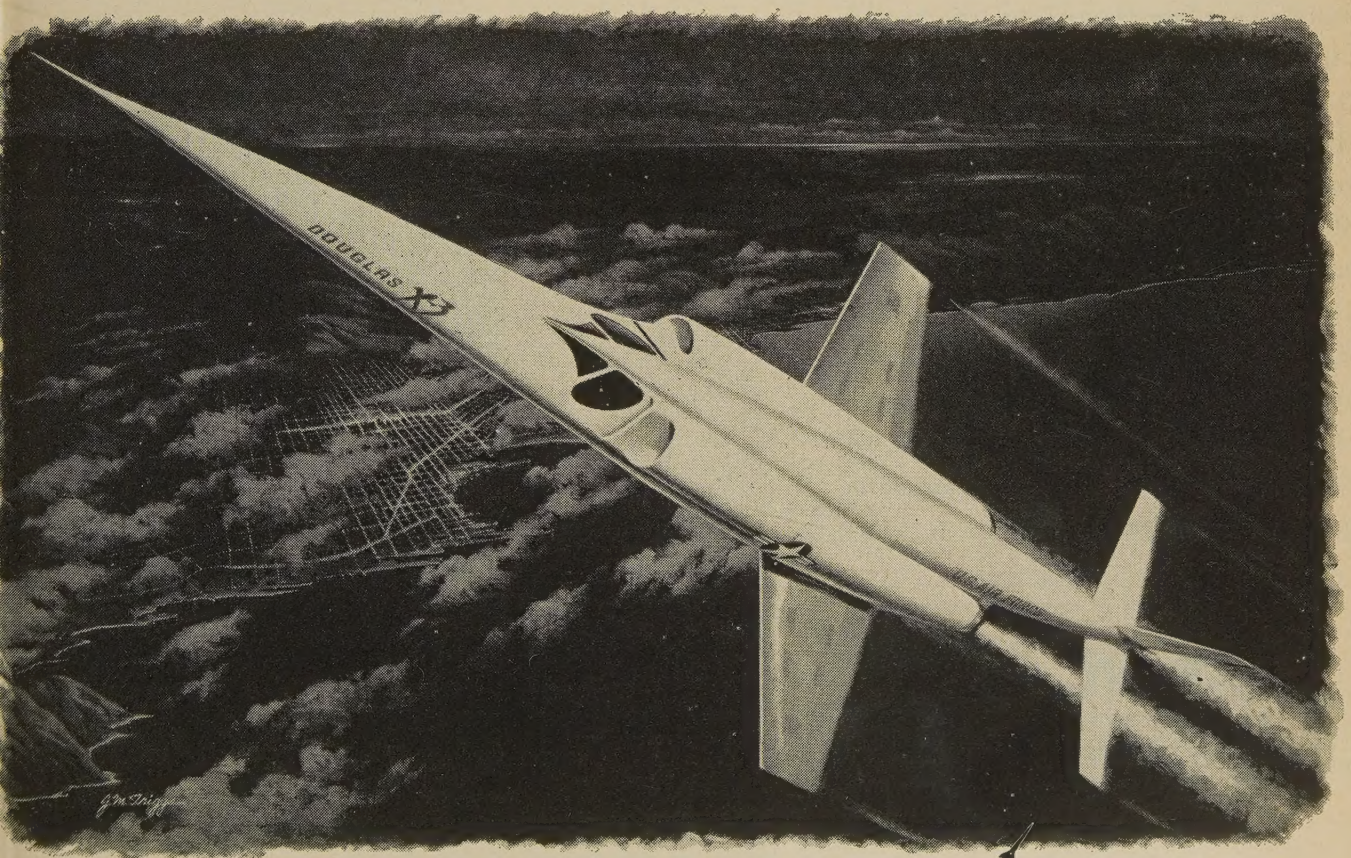
high-speed research aircraft

—the supersonic Douglas X-3

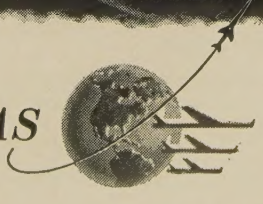
Now to the record-breaking Skystreak, the Douglas Skyrocket and the record-holding carrier-based Skyray, add this important experimental plane—the Douglas X-3.

Performance is secret, but a little can be told. Longer, heavier than a DC-3 transport, X-3 flies on wings smaller than a DC-3's tail—using conventional jet engines for *sustained* flight. X-3 has already contributed basic facts on insulation, refrigeration, and the use of heat-resistant *titanium*, while its payload of research instruments has been used to study the stresses and strains of flight at supersonic speeds.

Design of X-3 is another example of Douglas leadership in aviation. *Faster and farther with a bigger payload* is a basic Douglas rule.



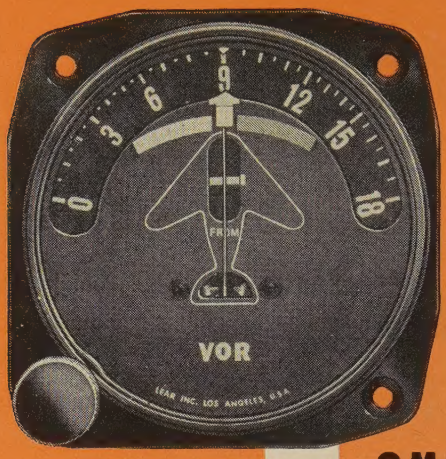
Enlist to fly with the U.S. Air Force

Depend on *DOUGLAS*  **First in Aviation**

NOW LEAR HAS 2 GREAT OMNI'S

IF YOU CHOOSE to fly the omni ranges with the needle presentation, the Lear OmniMeter is the easiest, accurate, and efficient way to do it. On the other hand, if you like the graphic simplicity of a picture presentation, you will want the Lear Omniscope. Either system—Lear OmniMeter or Lear Omniscope—can be added to your present Lear VHF system—or to any one of Lear's 12 different building block VHF combinations. You can, for example, have a tunable VHF receiver, crystal controlled VHF transmitter, low frequency and marker beacon receiver, Omni, VAR, and ILS—all in one compact, light-weight installation.

Specify Lear in your next plane. Have a complete Lear radio and omnirange navigation system installed at the factory before you take delivery. Lear is *standard* on many of the popular business planes.



OMNIMETER®
(needle presentation)

This is the new Lear three-in-one omni designed for pilots who prefer to "fly the needle." In one compact instrument, it combines the left-right deviation needle, the to-from meter, and a 360° course selector. A precision instrument throughout, built to airline standards of accuracy and ruggedness, but engineered to require a minimum of cockpit space.

OMNISCOPE®
(picture presentation)

Preferred by thousands of pilots because it is entirely automatic. "The Lear Omniscope presentation," says Leighton Collins, editor of AIR FACTS, "throws out all the mental juggling. It tells you your bearing. You don't think. You just tune in the station and hit the navigational jackpot."

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now hear this . . .

PERSONNEL

Hall L. Hibbard, director and vice president of engineering for Lockheed Aircraft, recently was elected to directorships in Lockheed Aircraft Service and its subsidiary, Lockheed Aircraft Service—International.

Ralph S. Damon, president of Trans World Airlines, has been named Chairman of the Committee on Operating Problems by NACA. **Bob Buck,** veteran TWA pilot, was named to the Subcommittee on Meteorological Problems.

John M. Beardslee was appointed Assistant Administrator for Operations of the CAA. His duties will include those formerly handled by Morwick Ross who resigned to join the Northrop Aircraft, Inc.

Dr. Theodor Buchhold has joined Ford Instrument Company as Staff Consultant to the vice president for engineering. **Kenneth Slawson** has been appointed. Assistant to the President of the Ford Instrument Company; and **Robert Armstrong** has joined the Quality Control Division as Assistant to C. E. Ellis.

G. Russell Tatum has been named general manager of Vitro Laboratories, a division of Vitro Corporation of America.

C. J. Higgins has joined Best Aircraft Corp. of Newark, N.J. as President; and **Fred Gebhardt** has joined Best Aircraft as Vice President.

Dr. Charles J. Breitwieser, Director of Engineering for Lear, Incorporated, has been elected a vice president of Lear.

Henry Magnuski recently was named Associate Director of Research in Motorola's Communications and Electronics Division. **Harold A. Jones** has been made Executive Assistant to Motorola's National Sales Manager, Eugene S. Goebel.

Robert E. Peach has been elected president and member of the board of directors of Mohawk Airlines; and **Joseph L. Lewis,** veteran Mohawk captain, has been named Chief Pilot.

Maj. Gen. William C. Senter, commander, Air Weather Service, will assume command of Oklahoma City Air Material Area, Tinker AFB, on May 1.

Harry W. Ellis has been named Midwestern Regional Manager for Electro Dynamic Motor Generator Division of the General Dynamics Corp.

Charles A. Sereno has been elected Vice President and General Sales Manager of Air Associates' electronic and mechanical products divisions.

Jim Brooks, inspection test pilot, has been transferred to Engineering Flight Test Section at North American Aviation.

Howard L. Hartman is now General Sales Manager of Aircraft Engine and Parts Company.

C. W. Greaves recently was appointed special assistant to the manager of Convair's San Diego Division.

William H. DuBois was appointed Chief Engineer for lining development, and **Edward J. Moyer** succeeds him as Chief Engineer of the Aircraft Wheel and Brake operation at Bendix Products Division.

L. N. Aikman has joined the executive staff of Dumont Aviation Associates.

Edward T. Martin is now superintendent of training for Flight Safety, Inc.

COMPANIES

Piasecki Helicopter Corp. has leased 240,000 square feet of space at the former Autocar factory at Ardmore, Pa.

Dallas Avionics has been awarded a contract for all communications activities of Pioneer Air Lines.

Scintilla Division is the new name of Scintilla Magneto division of Bendix Aviation Corp. "Magneto" was deleted as it actually is no longer descriptive of the size and scope of the division's operation.

Walmor Equipment Corp. has opened offices at 5411 West 104th St., Los Angeles.

Micromax Company, of Brooklyn, has changed its name to **Computer Instruments Company.**

Cherokee Airpark is the new name of the Commercial Airport at Tulsa, Okla.

AWARDS

Edwin A. Link, president of Link Aviation, has received the USAF's Exceptional Service Award for outstanding contribution to the defense effort.

Jacqueline Cochran became the first woman to receive the annual Frank M. Hawks Memorial Award.

James P. Barbour, manager of aircraft sales for Westinghouse Electric's Small Motor Division, and **Bascum O. Austin,** manager of aviation engineering department's control section, were awarded the Westinghouse Order of Merit.

AERO CALENDER

Apr. 5-6—Society of Plastics Industry, Inc. (Canada), 12th Annual conference. Hotel Mount Royal, Montreal.

Apr. 12—Society of Automotive Engineers, Second Annual Aeronautic Production Forum, Hotel Statler, New York.

Apr. 14—NACA symposium on helicopter research for American Helicopter Society, Langley Field, Va.

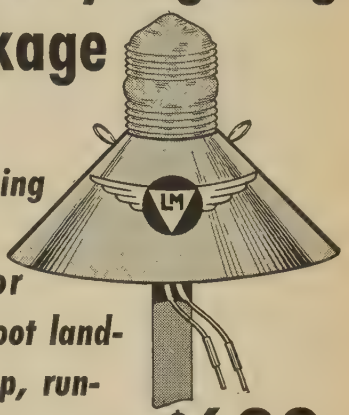
Apr. 21-24—Second Annual Student Paper Competition sponsored by Institute of the Aeronautical Sciences, Texas Section. Adolphus Hotel, Dallas.

Apr. 22-23—Joint meeting of RTCA, Franklin Institute Laboratories for Research and Development, Philadelphia Section of IAS, and Philadelphia Chapter of IRE, at The Franklin Institute, Philadelphia.

May 5-7—Third International Aviation Trade Show, 71st Regiment Armory, New York.

May 16-19—American Assn. of Airport Executives, Kentucky Hotel, Louisville.

Complete "Flying Farmer" Runway Lighting Package



Everything you need for 2000-foot landing strip, runway, or taxiway $600

Includes 18 stake-mounted runway units with clear lens; 12 threshold units with green lens; yellow cones, lenses, lamps, control switch, Penta-treated stakes, 10,000 feet plastic-covered No. 10 copper wire for direct burial.

Now you can make safer landings in darkness, dust, or fog with a dependable, electric-lighted runway system that costs only 30¢ per runway foot for materials.

Install it yourself. Just plow 6-inch furrows for cable, drive stakes for the units, hook up to regular 115-volt AC power. Needs no transformers. Lamps are 15 watt (105 lumens), giving 27 cp output.

This is a highly effective system, made by the makers of the famous Thermal Beam (TM) high-intensity lights for larger airports.

Also available: "Flying Farmer" kits for 2500- and 3000-foot runways. Mail coupon for complete information.

LINE MATERIAL
Airport Lighting LM

(A McGraw Electric Company Division) 152

MAIL THIS COUPON

Line Material Co. Airport Lighting Division, Milwaukee 1, Wisconsin SW-44

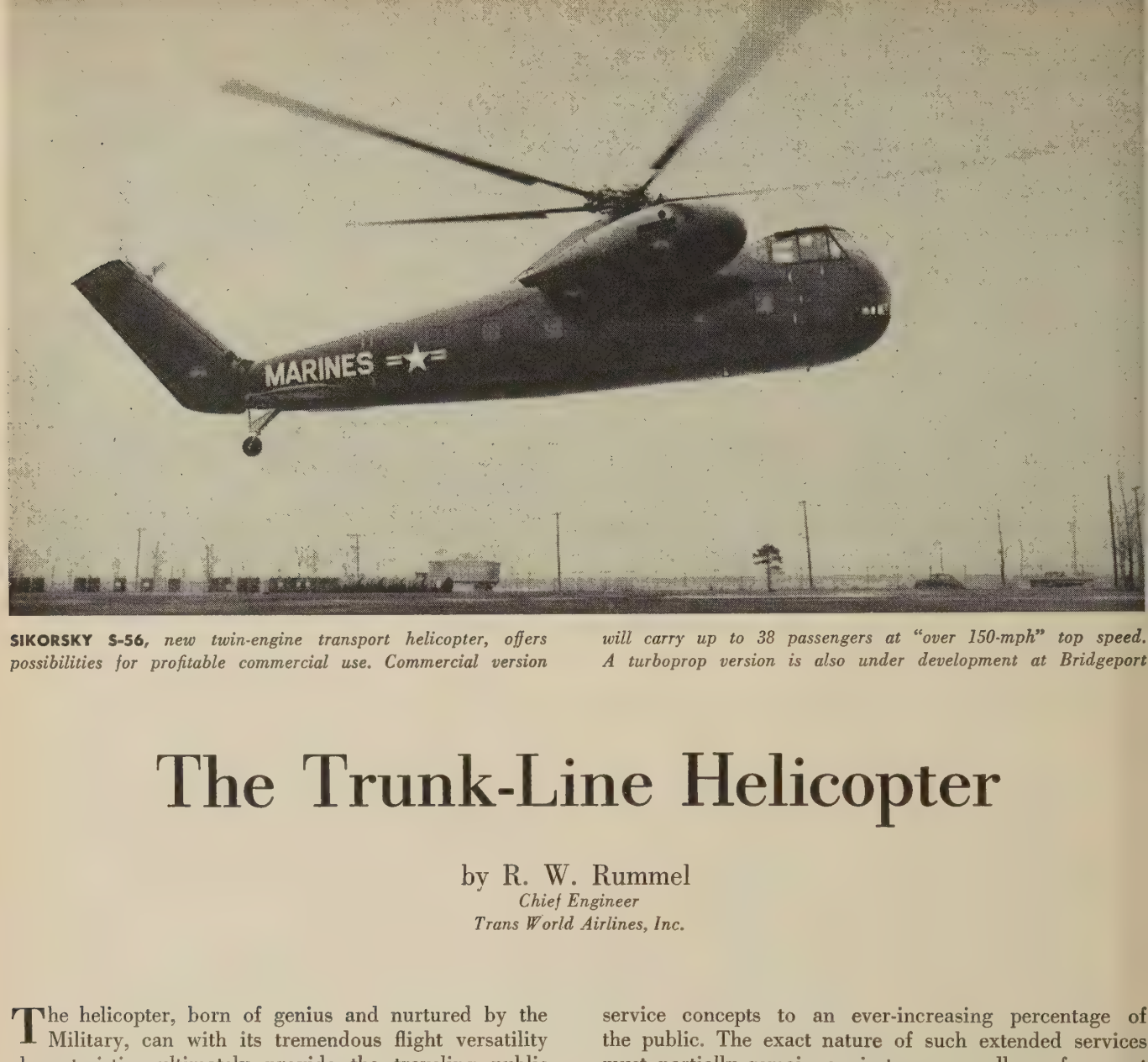
Please send me free folder on "Flying Farmer" runway lighting packages.

Name.....

Business.....

Address or Route.....

Town.....*State*.....



SIKORSKY S-56, *new twin-engine transport helicopter, offers possibilities for profitable commercial use. Commercial version will carry up to 38 passengers at "over 150-mph" top speed. A turboprop version is also under development at Bridgeport*

The Trunk-Line Helicopter

by R. W. Rummel
Chief Engineer
Trans World Airlines, Inc.

The helicopter, born of genius and nurtured by the Military, can with its tremendous flight versatility characteristics ultimately provide the traveling public with conveniences of service and time savings unattainable by other modes of transportation. In only a few short years the helicopter has emerged from highly experimental types into experience-tested machines capable of many tactical uses, including search and rescue, reconnaissance, liaison and observation, etc., as well as such commercial uses as carrying air mail and express in metropolitan areas. The development of the helicopter indeed has been rapid. Production has been increased from a relatively few machines during World War II to the presently large numbers of various types produced by manufacturers at impressive production rates. Performance and load-carrying abilities have been increased steadily and instrumentation and stability steadily improved. With the normal course of peaceful competitive evolution, it appears that in a relatively few years transport-type helicopters suitable for trunk-line use by America's airlines will be developed.

The helicopter in its refined development state will provide types of services that are not presently in existence, but which will augment and extend our present service concepts to an ever-increasing percentage of the public. The exact nature of such extended services must partially remain conjecture, regardless of present plans as these are almost certain to evolve and change as experience is gained and public reaction obtained. It certainly seems probable and likely, however, that for the shorter trip segments, say 200 miles and less, the helicopter can serve a useful purpose providing adequate supporting facilities (including judiciously located heliports) are made available.

Considerations of future services should by no means be limited to the helicopter as such but should also include other types of rotary wing aircraft, including the presently embryonic possibilities of convertiplanes. For example, it is not difficult to conceive the eventual development of a short or medium-haul transport equipped with small fixed wings and rotary wing lift assists which would be used only during take-offs and landings. Although the complexity of such an aircraft seems somewhat appalling, it is quite possible its potential utility would justify its development, and that the economical aspects could be satisfied. The chief competitor to the rotary-wing type for short-haul service may turn out to be a relatively conventional type airplane equipped

with power devices for maintaining wing lift at very low airspeeds. Turbine engines lend themselves nicely to this concept. Perhaps the eventual short-haul trunk-line vehicle will be a machine not presently envisioned at all but which, nevertheless, will be a logical outgrowth of current efforts combined with future experimentation and experience. However, of one thing we can be sure, whatever the type, when the manufacturers produce a vehicle that is capable of offering superior or more economical services safely, the scheduled airlines will be good customers.

The greatest consideration of rotorcraft design, aside from safety, should be to attain the lowest possible operating cost and at the same time the highest possible cruising speed. While many promising future development possibilities are on the horizon, the development of the large commercial helicopter is so imminent that this article is confined primarily to discussion of some economic aspects of and operating requirements for this type.

Before full advantage of helicopters can be realized, however, much additional experience must be obtained, airport and heliport facilities developed, and service patterns developed which are most advantageous to the traveling public.

The problem of locating heliports at the most strategic locations is intricate and involved not only from a cost and development standpoint but also from the standpoint of convenience to the traveler—which, perhaps, should be the prime consideration. It is probably true that nonresident passengers would wish to deplane at a central point near hotels, but at least some of the departing or arriving local residents might find a central heliport inconvenient to their homes. Thus, to some of the passengers present airport locations may not be as inconvenient as is now believed. The heliport should be located to serve the convenience of the greatest number of passengers, and in some localities several heliports may be necessary to accomplish this.

BELL HSL-1, *a twin-rotor helicopter for the Navy, also offers good possibilities as commercial trunk-line copter*

In addition to trunk-line service, the helicopter unquestionably will find expanded use in air limousine service from downtown heliports to outlying fixed-wing aircraft airports, for inter-urban service, providing a streetcar or bus-type service between closely knit communities of large metropolitan areas, and it is hoped that the advantages of mail-carrying helicopter services in large metropolitan areas will continue to be exploited.

Several helicopter manufacturers in the U. S. presently are working on the development of large helicopters which appear to offer possibilities for profitable commercial service. The development of such machines is now being supported by the Military to satisfy its requirements for moving troops and equipment from airports to combat areas and for other uses. Therefore, the application of these machines may be limited for a time to these rather than commercial uses. However, since the size and performance of some of these craft are such that commercial application of either of these machines or their successors appears feasible, they are of special interest.

Piasecki has developed a large passenger-carrying type helicopter which has recently flown. Also, information on Sikorsky's new twin-engine helicopter has recently been released. Bell's twin-rotor helicopter has been flying a number of months and, while not quite as large as the Piasecki, it is, nevertheless, impressive. Undoubtedly, other designs soon will be brought to maturity, and in the not too distant future other advanced types of machines will appear.

With respect to size, it appears that the minimum payload-carrying trunk-line helicopter should be capable of economical transportation of from 40 to 50 passengers with their baggage, and about 2,000 pounds of cargo. Early transport-type helicopters may not fully meet this specification, however, and may be powered with piston engines due to the development time required for installation of turbine engines of proven reliability. It is believed, however, that the economics of operation will be materially improved when reliable turbine-powered helicopters of suitable size become available.

The trunk-line helicopter, like fixed-wing aircraft, must have more than one engine for night and instrument flight or for flights over densely populated metropolitan areas. Certainly, most would agree that this is essential in the interest of both reliability of service and safety to be able to complete each flight satisfactorily or negotiate a safe landing at suitable alternates with one engine inoperative. This represents a particularly stringent power requirement for the large helicopter and one which, incidentally, gives the designer considerable reason to favor the installation of turbine rather than reciprocating-type powerplants.

In order to present a few comparative block speed and direct operating cost figures, a helicopter powered with two Pratt and Whitney R-2800 engines and having a payload of 10,000 pounds has been assumed. The fuselage would be about Martin 404 size. It is further assumed that this helicopter would have a cruising speed of 150 mph and would be a type which could reasonably be developed and made available for operation by 1956 or 1957. This assumed machine by no means represents the optimum development of the helicopter; instead, it is merely a hypothetical that could be initially

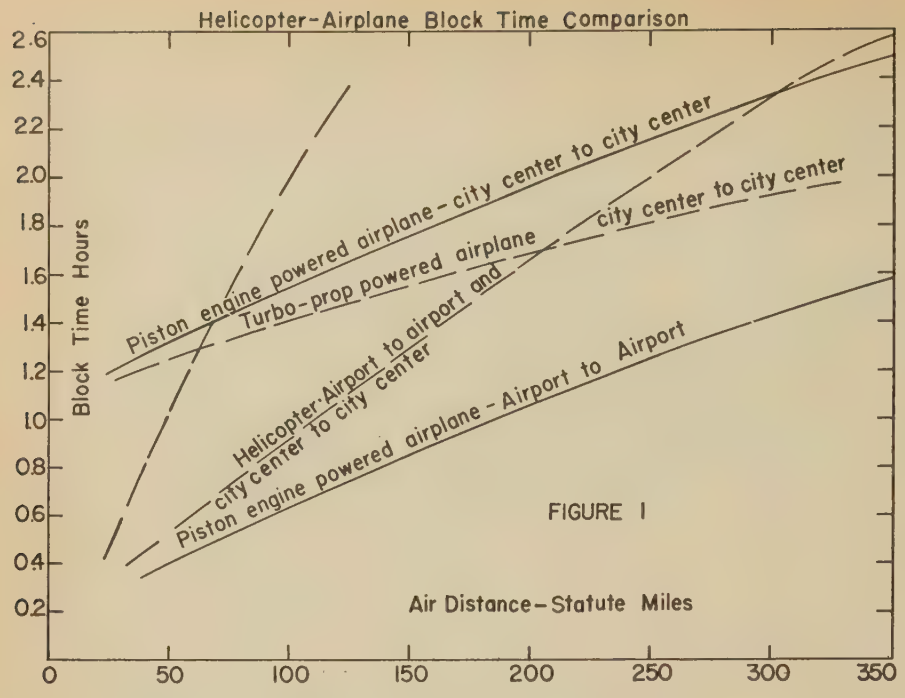


FIGURE 1

used in trunk line service.

Later types employing turbine powerplants no doubt would offer superior payload and performance. In addition, cruising speed would be increased from the assumed 150 mph to 180 or even 200 mph by such design exigencies as providing stub wings to unload the rotor, thus reducing tendencies of the receding blades to stall, or by using small diameter thrust propellers to achieve the same purpose, and no doubt by several other means, some not presently foreseen.

In order to illustrate block speed and direct operating cost characteristics, the assumed piston-engine powered 10,000-pound payload helicopter is compared with two twin-engined transport airplanes, one powered with Pratt and Whitney R-2800 piston engines and the other with theoretical turboprop-type engines. All costs are calculated and are made as reasonably comparable as possible. Following are brief summary characteristics of the three machines:

Performance	Assumed Helicopter	Piston Airplane	Turboprop Airplane
Climb IAS:	80 mph	160 mph	180 mph
Rate of climb:	600 fpm	830 fpm	1,000 fpm
Cruise IAS:	130 mph	200 mph	300 mph
Cruise altitude:	1500 ft.	5,000/15,000 ft.	5,000/20,000 ft.

It is also assumed that the helicopter would cruise at a constant altitude of 1500 feet irrespective of trip distance; whereas the cruising altitude of the airplanes would vary with trip distance.

Figure 1 compares the elapsed time of the airplane and the helicopter for distances up to 350 miles. It shows airport-to-airport time and also city-center-to-city-center time after allowing for ground transportation at both ends of the travel segment. Since the flight speed of the helicopter is considerably less than the piston-powered airplane, it cannot offer improved time over the fixed-wing airplane for distances greater than 50 miles if it is assumed both are operated from the same airport. If, however, downtown heliports are assumed, the helicopter could offer important city-center-to-city-center time advantages over the conventional airplane up to distances of 300 miles. It is also interesting to note that the helicopter can offer time savings over the railroads even on short-distance segments. The turboprop-powered airplane reduces the advantage of the helicopter to trips of 200 miles or less because of the turboprop's greater speed.

With respect to direct operating cost, the assumed helicopter does not show advantages over the piston-engine powered airplane. The cost per passenger mile at 60% passenger load factor is estimated to be 3.7¢ for the airplane and 5.5¢ for the assumed helicopter. These figures apply for a typical 100-mile flight for both types. Calculated helicopter costs are relatively higher for two primary reasons: first, significantly lower block-to-block speeds; and, secondly, the assumption of a relatively high purchase price for the helicopter as compared to the piston-engine powered aircraft. The latter assumption is not necessarily correct in all airline situations, for if the airplane and helicopter were compared on a contemporary cost basis, the difference in direct operating costs would be considerably less.

Also, perhaps partially accounting for the relatively high direct operating cost is the assumption that, contrary to claims of some of the helicopter manufacturers, the maintenance of the rotor and the rotor-drive mechanisms with their customary shafting and gear boxes would be greater than maintenance costs of the wing and propellers of the fixed-wing aircraft. Future experience alone will either substantiate or repute this assumption.

Even with somewhat pessimistic assumptions relative to the direct operating cost of the assumed helicopter, it can be shown that effective direct seat mile costs are less than or about comparable to the airplane if account is taken of reasonable limousine fares. On the assumption that service would be offered from city center to city center, then it seems entirely equitable to take into account the limousine fare which would have to be spent by the downtown traveler if he were to take the same trip by plane. This would not be significant to the passenger from an out-of-pocket cost viewpoint, but would be very significant on a fare-per-mile basis. Assuming $1.25 limousine fares at trip beginning and end, it can be seen, by referring to Figure 2 *(page 30)* that the effective direct seat mile cost of the airplane is actually greater than that of the helicopter for trip segments up to 130 miles.

It seems very promising, even at this early stage of development, that the trunk-line helicopter can be shown to be passibly economical. This is most encouraging since it is certain that with additional develop-

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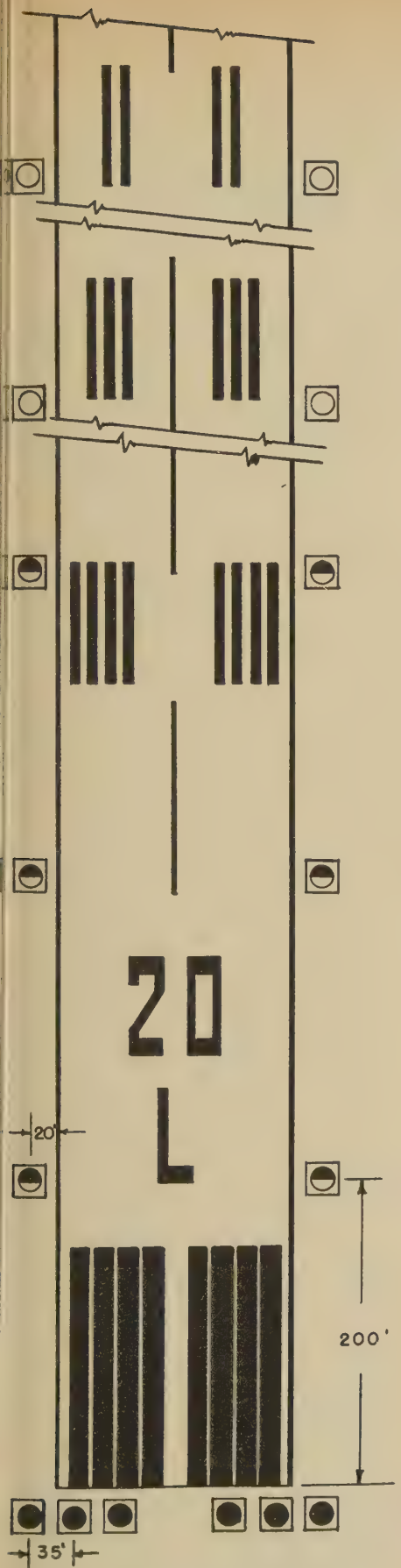


ALL WEATHER RUNWAY

RUNWAY *markings must provide the pilot with continuous directional guidance if a restricted visibility take-off is planned*

Restricted Visability Take-off

by Harley D. Kysor
Aviation Consultant

Jump in and go! Sounds easy—and it is when applied to present-day automotive travel. In the aircraft field, however, it isn't that simple. Decisions to be made before and during any flight are many and varied if safe operating procedures are to be complied with—be they of common sense or of regulation. Those in and near the flying profession know that most pilots have been confronted with the problem of determining whether or not a safe take-off could be made in weather conditions that reduce surface visibility to a mile or less. Obviously, if a flight is to be successfully completed, the take-off must be survived. However, when conditions are such as to make a take-off unsafe, it is imperative that all personnel quickly and surely recognize that fact through a definite understanding of the contributing factors involved and knowing why they constitute a hazard.

Primary consideration should be given to the weather phenomena causing the restricted visibility. Conditions of local haze or smoke present no problem, and take-off with visibility as low as a quarter-mile can be accomplished generally with safety, provided other conditions, as discussed below, prevail. Fog and light rain likewise are not serious as long as some thought is given to the following factors:

(1) Possible attendant icing conditions.

(2) Adverse effects of high humidity and temperature on engine performance.

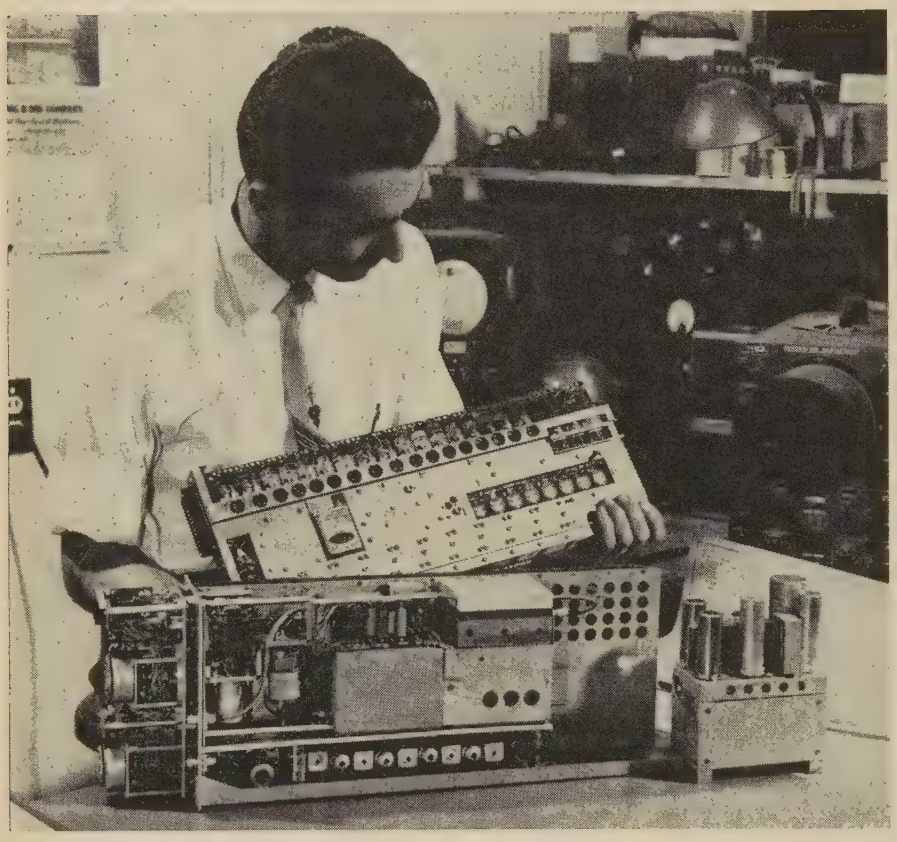
The latter factor is one not generally realized and, in most operations, is not critical. However, it is well for the pilot to remember that high humidity and temperature reduce engine power output. Therefore, the adverse effects of high temperature and humidity should be definitely taken into account in any proposed take-off at maximum gross weights on runways of limited length. Power curves have been plotted on several of the more widely used reciprocating engines giving the approximate effect of temperature, humidity, and barometric pressure on the brake horsepower (BHP) an engine will develop when operated at the MAP (uncorrected for carburetor air temperature) and RPM specified for a particular engine. At a dewpoint temperature of 75°F, carburetor air temperature of 30° C, field barometric pressure of 29.00, an engine is not expected to develop more than 92% of the rated horsepower. There are cases on record involving a power loss as high as 15% when humidity and temperature have been not abnormally high in areas such as Houston, Texas. Therefore, an engine rated at 1200 hp would generate about 1020 hp, and an engine rated at 450 hp would generate about 383 hp. This is something to think about when the gross weights run close to maximum. It is not necessary to elaborate here on the precautions to be taken when known or forecast icing conditions accompany snow or rain. Blowing snow and driving or heavy rain may have dangerous turbulence as well.

Difficulties experienced in low-visibility take-offs and the consequent hazards depend to some extent on runway marking and lighting. A pilot would have obvious troubles in an attempted take-off with quarter-mile visibility on an asphalt runway which was devoid of markings of any kind, whereas under similar conditions, the existence of a clearly marked center-line greatly simplifies the problem. High-intensity runway lights are a good secondary aid and in air-carrier operation they influence the legal minimum take-off visibility. But they should not supplant the runway markings as a primary reference. Runway lights are of assistance in

(Continued on Page 31)

by Gil Quinby
National Aeronautical Corp.

Shakedown Cruise of the DME



PILOT-AUTHOR *Gil Quimby demonstrates the ease with which the interrogator unit of the NARCO DME can be disassembled for maintenance. Unit fits a standard ½ ATR mounting*

Hollywood has no monopoly on new dimensions. Having just completed a 20,000-mile cross-country flight using Distance Measuring Equipment, I'm happy to report that aviation now has a new dimension in the cockpit. The miles meter is taking the place of pilotage.

The history of air navigation is a long series of tricks and devices, calculations and maneuvers to get around one basic lack—we didn't know how far we had to travel to get where we were going. Multiple navigation aids were required to resolve a single unknown—distance.

Now Distance Measuring Equipment hands us the answer in a simple three-inch instrument that's as easy to read as a clock.

My cross-country was actually a criss-crossing of the continent in two installments, for an operational test of the new Narco DME which has just been put on the market. On November 5, I took off from Philadelphia for Cincinnati and St. Louis, then went on to Oklahoma City, El Paso, Los Angeles, San Francisco, Phoenix, Oklahoma City, Nashville, Washington and back to Philadelphia. The second route had a north-south slant—Philadelphia, Chicago, Minneapolis, Davenport, Dallas, San Antonio, Houston, New Orleans, Atlanta, Tampa and return. In between these major trips were a couple of shorter "out and back" excursions.

My plane was Narco's six-year-old *Bonanza* 2769V, equipped with Narco's DME prototype unit, "Number Zero". In the course of 140 air hours I made contact with 56 DME ground stations. It's no exaggeration to say that in the northeast quarter of the country, DME has arrived. East of the Mississippi and north of the Mason Dixon line you can navigate by DME at all times, with only an occasional 20-minute gap. West of the Mississippi, DME coverage is good along the airways linking Chicago and St. Louis with Cheyenne and San Francisco, but north of that it's still spotty, and the same must be said for both the southeast and southwest.

It's no myth, however, that installation of DME stations is going full steam ahead in all parts of the United States. The CAA's installation program is progressing so rapidly that each new list of stations is out of date by the time it's released.

Profiting by experience with the installation of omnirange stations—a program that dribbled along for better than five years—the then CAA Administrator Charles F. Horne sailed into the DME program with the largest single procurement contract ever let by the CAA. The contract, awarded to Hazeltine Electronics Corp., called for the manufacture of some 450 DME ground stations with the necessary appurtenances.

The installations of DME stations began in 1953 and by June of this year the program will be as far along as the omni program was at the end of three years. In other words, with DME equipment now available to the flying public, the necessary ground stations are ready to flash back the reply pulses.

A typical sequence involving DME navigation begins on the ground during run-up as soon as the aircraft radio equipment is fired up. Turn the DME switch to "ON", and in a few seconds as the tubes get warm the miles meter will begin to search. After a one-minute warm-up, the interrogator is in full operation. The standard crystal-controlling DME

Cross-country test flight in a DME-equipped Bonanza covers 20,000 miles, proves the accuracy and utility of Distance Measuring Equipment, and turns up new navigational uses of the versatile DME

channel selector may be set immediately for the frequency of the station to be used after take-off. This frequency is in megacycles and tenths, and is set to the VHF frequency of the VOR or ILS localizer at which DME is to be used, so the pilot needn't worry about a new set of frequencies.

It's the job of the DME in the airplane to look for an answer in the form of a DME ground-station reply signal. While searching, the needle on the miles meter moves continually, and fairly slowly, from zero to the top of the scale, then back again with a quick flip. Short of complete power failure, anything that denies the unit a proper reply, *i.e.* antenna shadow, station beyond line of sight, or even malfunction of ground or airborne equipment—anything interfering with the reply will cause the needle to keep on searching.

Once contact is made with a ground station, the airborne DME "locks" on the reply signal, and the needle indicates the distance to the station in statute miles. Two scales on the DME instrument on the panel permit long-range readings from 0-200 miles or, close-in, extremely accurate readings from 0-20. When you are approaching or going away from a station, the miles meter shows the slant distance between the plane and the DME ground site. When the plane is directly over the station, the DME reading shows altitude above the ground in miles.

My entire trip was navigated with no aids other than DME, omni, and a Jeppesen Air Route Guide (which, incidentally, provides just about all a pilot needs to make full use of this new kind of navigation). I crossed the country twice without ever needing to identify a town or a river, a bridge or a set of railroad tracks. Certainly, this new dimension takes the pain out of pilotage.

During seven weeks behind the DME dial, virtually every day brought added proof of the unit's complete accuracy as well as its versatility.

For one thing, you don't catch DME lying. Maximum tolerance is ¾ mile or 2½% (which is a lot closer than most pilots will dead-reackon) and it's type-certificated to this specification. When a new ground station is flight tested, the characteritsic under scrutiny is its distance-altitude pattern, not the accuracy of the DME. And when DME locks it has to be right. It's "fail-safe", for that needle will keep on searching unless and until it comes up with the right answer.

Professional pilots who've already had experience with DME are inclined to trust it implicitly. I turned up amusing proof of this over Dayton, where Charlie Shaw (of Lunken Airport, Cincinnati) and I were running some sensitivity tests on the DME.

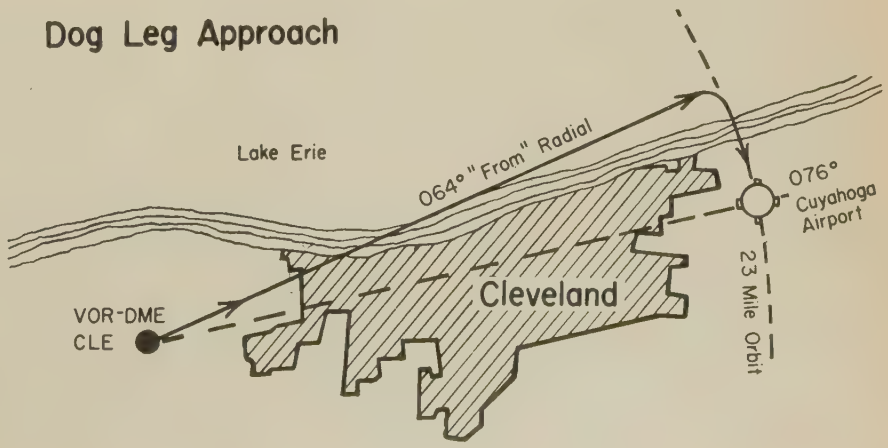
Conditions at Dayton were smoky and marginal and we had permission from the tower to remain on top above 4,000 ft. Later, we asked clearance to descend into the haze to check reactions below 4,000. Permission was granted with the proviso that we report when leaving each altitude. We were guarding the Dayton tower frequency throughout.

A TWA airliner called in and was cleared for approach, with the Day-

(Continued on Page 33)

NARCO DME *gives distance in two ranges: 0 to 200 miles in upper photo; 0 to 20 miles for close-in work (center photo). Freq selector switch is shown lower photo*

DIAGRAM *shows how DME may be used in marginal weather to make "dog leg approach" that takes aircraft around congested area lying between VOR and airport*



PARTICIPANTS *of Round Table on Human Engineering were (left to right) Dr. F. V. Taylor, Naval Research; Dr. W. F. Grether, Aero Medical Lab; Capt. W. L. Smith; M. J. Johnson, Johnson Aircraft Engr.; Col. J. Talbot, ARDC; LCdr. Houston, BuAer; S. W. Van Court, R. W. Lane, J. H. DuBuque, observers; J. Lederer, Cornell-Guggenheim; Dr. B. G. King, CAA; A. W. Reichel, Kearfott; Dr. McFarland, Harvard Univ.; Moderator LCdr. Hoover, USN; J. G. Wohl, ONR; R. B. Blakeslee, Glenn L. Martin; Dr. J. Orlansky, Dunlap & Assoc.; R. S. Raven, Westinghouse; Dr. Berrien, Institute for Research in Human Relations*

Human Engineering in the Aircraft Industry

Meeting indicates need for close working relationship between Human and Design engineers; that Human Engineering should be better utilized by Industry

LCDR. HOOVER *joined Navy in 1934; went to BuAer, '42, served with Special Devices Center until '49; received BS in Physics, Neb. U. '51; went to Naval Research, '53*

Moderator: LCdr George W. Hoover *(Office of Naval Research, USN):* "The subject under discussion today, gentlemen, is 'Human Engineering in the Aircraft Industry.' In order to provide a baseline for discussion, I would like to offer the following definition. Human Engineering means engineering for human use. It takes into account human capabilities and limitations, both physiological and psychological, in the design of human-operated and maintained machines. Human engineering serves to integrate man, machine, and environment for the most efficient operation. The application of human engineering to machine design results in increased effectiveness of the man-machine system, increased human safety, reduced costs of production, maintenance and redesign, and lowered requirements for the selection and training of operators and maintenance men.

"If we are all in agreement on this definition, we can proceed with the discussion. The first item I'd like to bring up is the question, 'What kinds of problems do engineers face in designing aircraft, airborne devices and systems for human use?' Let's start with an engineer and then follow with a psychologist to see what help can be given to solve the problem.

"Mr. Blakeslee, can you mention any particular problem you are facing in the design of aircraft equipment?"

Raymond D. Blakeslee *(Design Development Engr., Glenn L. Martin Co.)*: "The first of the problems involving human factors we encountered in our Weapon System Evaluation Group was the problem of high-speed flight in turbulent air—the vibratory effects of gusts, effects of elevated temperatures, crew escape problems, whether or not it is feasible to consider operations in that environment, and what steps would be necessary to make the human in the carrier capable of carrying out his duties efficiently.

"At the beginning we were novices in this field, and our first job was to find out what data existed. Using Dr. Ross McFarland's excellent book, "*Human Factors in Air Transport Design*," we started to collect data to find out about the effects of the environment. We have made some progress, but a world of work still remains to be done in that field. This work has to be carried right into the actual design of weapons systems. Our first studies of the problem of gust buffeting, vibration isolation and fatigue effects are just scratching the surface, but they have had some

DR. JESSE ORLANSKY received his PhD from Columbia in '40 served as Lieut., USNR '43-'46; became Vice Pres., Dunlap, in '48

DR. ROSS A. MCFARLAND graduated U. of Mich. '23; Harvard, '29; is international authority on human factors in transportation.

R. D. BLAKESLEE joined the Glenn L. Martin Co. in '40 as Structural Engr.; currently is member of Weapons System Evaluation Sect.

COL. J. M. TALBOT entered service in '39; has devoted career to practice of Aviation Medicine and research in atomic medicine.

LCDR R. C. HOUSTON has PhD from U. of Maryland; is Navy pilot; currently assigned Presentation Systems Branch of Navy BuAer.

JEROME LEDERER, Director of Cornell Guggenheim Aviation Safety Center, is Founder and Director of Flight Safety Foundation.

DR. F. K. BERRIEN has been conducting human engineering studies for Navy since 1951. He has PhD degree from Ohio State Univ.

W. L. SMITH joined U. S. Air Mail Service as pilot in '19; has devoted large part of his life to development of all-weather flying.

ROBERT S. RAVEN has MA degree from Stanford Univ.; joined Special Prod. Div., Westinghouse in 1946; the Air Arm Div. in 1952.

M. J. JOHNSON graduated Purdue in '38; was Mgr. Aircraft Sales, Elastic Stop Nut, '44; set up own Sales and Engr. Co. in 1946.

DR. F. V. TAYLOR received PhD in Psychology at Princeton in 1935; taught there until 1944; joined Naval Research Lab, '45.

JOSEPH G. WOHL is graduate of U. of Wis., and is currently a candidate for Master's Degree, Engr. Admin., at Geo. Washington Univ.

DR. W. F. GRETHER has PhD from U. of Wis.; served as Psychologist Officer, AF, during war; later worked in Human Engr. at WADC.

A. W. REICHEL served with Marine Corps 1944-46; became Engr. Coordinator, Kearfott Co. in '50, and Engr. Business Mgr. in 1952.

DR. B. G. KING received his AB and MA from U. of Calif.; served as Cmdr., Navy, during war. Dr. King joined the CAA in '47.

results as far as directing our design is concerned."

LCdr. Hoover: *"Dr. Berrien, what would you suggest in the way of handling this type of problem?"*

Dr. F. K. Berrien *(Director of Research, Institute for Research in Human Relations)*: "The problem of environmental influences on the pilot is, of course, of vital concern to the engineers. In this particular case, studies on the stress effects of flying in turbulent air might be done in a variety of ways.

"One of the first things that comes to mind is the possibility of metabolism studies, *i.e.* measuring rate of oxygen consumption. Making such studies would impose no particular strain or unusual condition on the pilot since he is already wearing an oxygen mask. I am not prepared to say whether these metabolism studies would give any clue as to the differences in physiological level, but this is one type of approach that might be made to the problem. The question is whether the pilot, under these environmental conditions, is subject to any unusual physiological or psychological strains and to what extent these would affect his flying accuracy or capabilities. Certainly, the metabolism studies might give some indication of increased effort that goes into flying in turbulent air."

"FUNCTION *of the human engineer," reported LCdr. Houston (right), "is to participate in determining how each instrument will be used and conditions under which it will be used"*

OBSERVERS *were (left to right) Cmdr. K. Scott, NATC; H. L. Dodson, NATC; H. J. Older, Psychological Research; Maj. Atherton, NATC, USMC; and William Littlewood, American Airlines*

"PROBLEM *of environmental influences on the pilot is of vital concern to the engineers," said Dr. Berrien (right). ". . . is the pilot subject to any unusual physiological stresses and how it affects his flying"*

Dr. Jesse Orlansky *(Vice Pres., Dunlap & Associates, Inc.)*: "Before worrying whether any stress effects will be present, we should ask a competent person to describe very precisely the expected environment. Here, I have in mind the anticipated magnitude of vibration, temperature, gust buffeting, etc. Then the question is, 'Can a man do a good job under *these* conditions?' A large part of the answer depends on just what his job is going to be.

"Checking with Dr. McFarland's book, for example, will quickly tell us whether a man can tolerate these conditions, and it may turn out that no research is required. If, as very often occurs, we don't know how a person would react, we have ways of finding out. That would involve extrapolation from known data, inspired guessing or some test observations. Many people know how to do this."

LCdr. Hoover: *"All this has brought out the fatigue effects of vibration. Now how about the ways of making it easier for the pilot to fly under these stress conditions?"*

Dr. Franklin V. Taylor *(Head, Psychology Branch, Naval Research Laboratory)*: "One approach would be to make an analysis of what the pilot's task or tasks would be under these circumstances, *i.e.* flights in turbulence in conventional aircraft with conventional instruments. After that has been done, the next step would be to consult various sources of information about what people can do, task-wise. Then, if it were found that these tasks imposed a greater load on the man than he could handle over periods of time commensurate with those expected, the next thing would be to look into ways of lightening the load; that is, the engineering possibilities of redesigning the displays and the controls.

"That would actually be the approach we would make. Now how far we could go would depend on circumstances."

LCdr. Hoover: *"Mr. Blakeslee, now that you have heard some of the opinions regarding an approach to your problem, do you think that human engineering by those people actively engaged in this field could be of benefit to you in this problem?"*

R. D. Blakeslee: "Very definitely. We have NACA data regarding the environment in which we expect to operate, and the indications are that we can take care of the aircraft's structure, given more information and more testing, but we cannot ignore the human crew members."

Dr. Barry G. King *(Research Executive, CAA)*: "There are considerable data, of course, on the effects of vibration on man. These have been developed through the SAE Riding Comfort Research Committee; through studies by Goldman of the Naval Medical Research Institute, who is working specifically on mechanical or solid-borne vibration; by Lippert of Douglas Aircraft; and through the acoustical energy (airborne and solid-borne) studies by Parrack of the Air Force. There are studies on the mechanical impedance of the body which are going on in ballistocardiography which are related to your problem. The farm tractor people have studied the vibration problem, too. Some tolerance curves have been set up for man as the result of data developed through these and other sources.

"There also are studies going on with regard to the stability of the body, in other words, the ability to resist disorienting forces."

R. D. Blakeslee: "We have gathered together information from many of these sources you mentioned, and have plotted tolerance curves in terms of amplitude and frequency. Working with these curves and what environmental data we could get our hands on, we found that sometimes we were seemingly in intolerable zones, but we don't know how far we should go in trying to remove the operator from those intolerable zones to more favorable zones . . . we don't know how much isolation is required without knowing more about the whole problem of human tolerances."

Jerome Lederer *(Dir. Cornell Guggenheim Aviation Safety Center)*: "On this broad problem of human engineering, I'd like to know whether the human engineers want to explore the environmental factors themselves and see what they are, or do they rely on the engineers to give them the information? What is the division of responsibility?"

Dr. Walter F. Grether *(Chief, Psychology Branch, Aero-Medical Laboratory, Air Force, Wright Air Development Center)*: "I would have to agree with Dr. Orlansky that it is the business of the engineer, not the human engineer, to describe the environment as nearly as possible. That has to be done before we, as human engineers, can get the right kind of tolerance data."

J. Lederer: "If I may, gentlemen, I'd like to bring up a typical case which certainly indicates that you have to carefully select the people from whom you get the information and you have to know whether or not they are using their imagination. We recently put out a bulletin on the design of emergency exits. We covered location, size, configuration, instructions, and included visibility, movement of control direction, force, and disposal of the emergency exit. And we printed a photograph of a very good one. Now, however, I find out that in a recent incident it took 20 minutes for the people to get out of this particular airplane! It seems that when this exit was designed and tested, the people were sitting in their seats when they opened it. If you stand up and try to open it, you can't do it easily.

"Someone was not using his imagination when that exit was designed, and if the human engineer doesn't get all his factors, he isn't able to do a full job. I wonder what control you have over that . . . and if you are sure you are getting all the information?"

"BEFORE *worrying whether any stress effects will be present," Dr. Orlansky (right) declared, "a human engineer should ask competent person to describe precisely the expected environment"*

Dr. B. G. King: "I take some exception to designing experiments for solution of a limited problem in a specific airplane when a broader approach would result in data which are generally applicable, and could be used in the solution of a number of problems. In the field of human engineering it seems to me that if we determine the bodily characteristics and tolerance levels to acoustical energy for man and establish a basic chart in terms of our stress, then when any specific problem is defined, we can pick out our point in the curve and find out where we are. We have responsibility for defining man's reaction to stress or tolerances at various levels, and if there were an opportunity to undertake a general study and make a general tolerance chart, we'd be better off working with it than just picking up these problems piecemeal. This approach is far more economical in the long run."

LCdr. Hoover: *"To sum things up, Mr. Blakeslee seems to have a double problem; one, the fatigue effects and the strain and stress on the crew; and two, the problem of design of the aircraft itself, including instruments and controls, so that it can be made easier to fly under these conditions.*

"Data are available to help solve both of these problems, and the source of that data is in the results of the human engineering studies.

"Another point made was that the source of the requirements themselves must be proper. In other words, they must be accurate before they are handed to the human engineer.

"Going from the aircraft itself to the equipment, Mr. Reichel, will give us your comments?"

Andre W. Reichel *(Engineering Business Mgr., Kearfott Co.)*: "The equipment manufacturer depends a great deal on the aircraft manufacturer for his information regarding the manner in which the information supplied by the equipment is supposed to be given to the pilot. The difficulty lies in the fact that each mock-up board, each aircraft manufacturer, and each specific problem requires a totally different presentation. Right now there is no standard other than certain AN specifications on dial markings and dial sizes and a general specification for keeping the number of dials to a minimum. Beyond that, we have nothing to work with, and every instrument we have ever built has been different from the one just before it. What a particular instrument should look like has always been decided by one person or one group of persons.

"The N-1 compass is a good example of this so-called change. We started out with a 3-inch dial on the repeater indicators, then in the middle of the program it was upped to a 5-inch dial. The dial markings were changed, the painting was changed . . . all as almost an after-thought instead of in a coordinated fashion. Someone looked at a particular dial and decided it should be changed a bit. Although some aero-medical advice was sought, we never did get a statement as to what really was best in the particular circumstance.

"If someone could tell us how we can obtain the actual human requirements, then we probably could design for them. However, we must know well ahead of the time a system must go into production.

"An important point that has to be considered by a manufacturer is that at the end of a year he has to show a profit to the stockholders. He cannot change in midstream because it is too costly and he would lose money. Therefore, what we would very much like to see is a general chart such as Dr. King mentioned. Then we could say, 'In the present state of the art, this is feasible' . . . or maybe it will not be quite as good as the chart indicates, but is the best we can do at this time and we will continue to do development work along the lines the chart dictates."

LCdr. Hoover: *"Comdr. Houston, can you tell us what is being done by the Navy to solve this problem."*

LCdr. Robert C. Houston *(Aviation Psychologist, BuAer, USN)*: "The Navy's Bureau of Aeronautics is attempting to standardize its instrument specifications, and I believe Mr. Reichel is aware of these efforts. We cannot completely eliminate the special problem of each instrument, but we can build up a body of research data, more than we have now, to refer to when we consider the design of specific instruments. It is the human engineer's function to participate in determining how each instrument will be used and the conditions under which it will be used. From that information we can go ahead and decide how a particular instrument should be designed."

LCdr. Hoover: *"Col. Talbot, from the Air Force standpoint, are you doing similar work in this field?"*

Col. John M. Talbot *(Director of Human Factors, ARDC, USAF)*: "On the instrument presentation picture, we are cooperating with the Navy in this large development program to come up with a presentation technique that will remove many of the objectionable features of the present instrument presentations.

"We also have our *'Handbook of Instructions for Aircraft Designers'.*

"WE'D *be happy to have human engineers in our organization," reported Mr. Reichel, "if we had assurance their opinions agreed with those of human engineers on the mock-up board"*

"Dr. Grether may have something to add with regard to what the Air Force is doing in an attempt to provide these tables that are so badly needed for engineering purposes."

Dr. W. F. Grether: "The handbook Col. Talbot mentioned does not handle the detailed kind of problem that Mr. Reichel was talking about as far as instruments go. It handles the problem at a more gross level for the aircraft rather than the details of the equipment in the aircraft.

"Along the line Cmdr. Houston mentioned and in addition to the Navy effort that he mentioned, there is now a rather large effort underway to prepare a human engineering guide. This is a joint Army-Navy-Air Force effort in which the Navy has a primary responsibility. The part dealing with standard recommendations on instrument markings is already available in draft form and has been used by some people. This handles quite a few general recommendations, such as marking size, marking spacing, marking dimensions, letter size and style for normal conditions of aircraft lighting and panel distance, etc. It won't answer all of your problems for specific instruments because, as has already been mentioned, you must consider the particular conditions and manner of use, and this can't always be anticipated in a general guide."

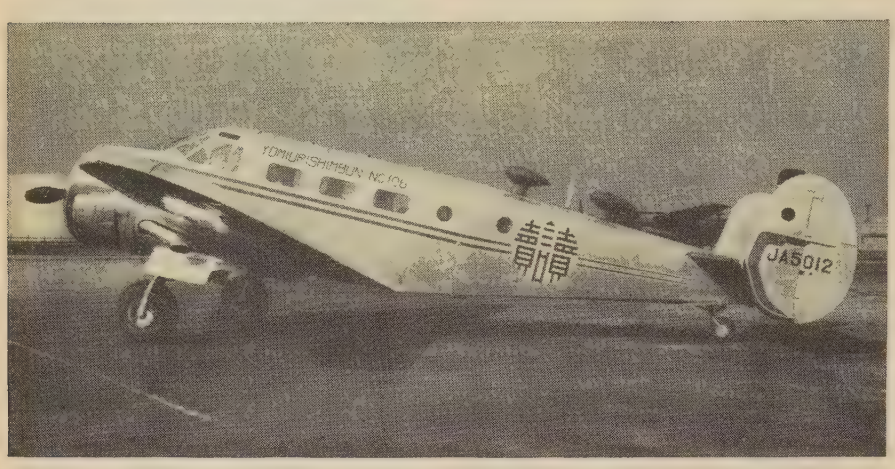
LCdr. Hoover: *"Dr. King, is there any work similar to this being done by the airlines or the CAA?"*

Dr. B. G. King: "Primarily on the basis of developments in the armed services, the Civil Aeronautics Board has carried forward a vigorous program for standardization in aircraft instruments. The degree of standardization which should be attained has been the subject of considerable con-

(Continued on Page 34)

SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS



YOMIURI PRESS *in Tokyo has added a new Beech D18S to its fleet of business aircraft which includes a Cessna 195, a Piper PA-20, Bell 47D-1 helicopter and another Twin Beech*

CAA Booklet Reports Increase in Business Flying During '52

Washington, D.C. Business flying has increased almost 900% since 1940, according to a report just issued by the Civil Aeronautics Administration. The report, contained in a booklet entitled "The Airplane at Work for Business and Industry," states that in 1952 business flying in company or individually owned aircraft totaled 3,124,000 hours, some 600,000 more than the revenue hours of the scheduled domestic airlines.

CAA found 11,100 company-owned aircraft accumulated 1,853,000 hours in 1952, and 19,400 individually owned aircraft logged 1,271,000 hours of business flying. Manufacturing and mining (exclusive of aircraft, automobiles and petroleum) account for the largest amount of business flying—616,000 hours. Planes used in farming, ranching and related activities flew a total of 559,000 hours, and the aviation industry itself ran up a total of 427,000 hours of business flying other than on a for-hire basis. The petroleum industry chalked up 371,000 hours, while aircraft used in connection with construction and real estate operations followed with 286,000 business hours.

In other "work" categories, commercial agricultural activities racked up 707,300 hours. This represents a gain of 3.2% over 1951. Passenger and cargo-carrying for hire, including that done by irregular carriers but not military contract or scheduled airline flying, was up 6.8% to 703,000 hours in '52. Patrol, survey and aerial advertising registered the biggest gain—up 31.5% to 317,000 hours. In this category, pipeline patrol was the busiest single type of flying, with 101,900 hours. However, surprisingly large totals were recorded for some of the more unusual operations. Hunting predatory animals, for example, consumed 21,600 hours of flying.

The report also offers data on radio equipment in aircraft used in these general aviation operations. It shows that 34,050 aircraft, or 57% of the aircraft engaged in general flying in 1952, had some form of radio equipment.

A limited number of copies of this booklet is available at 50 cents each, and may be had from the Department of Commerce, Washington 25, D. C.

Companies Sign Long-Term Agreement to Continue Use of Airport

Cleveland, Ohio. The Diamond Alkali Co., Eaton Mfg. Co., Lubrizol Corp., M. A. Hanna Co. and Thompson Products, Inc., have signed long-term agreements to continue to use Lost Nation Airport, Willoughby, Ohio. The agreements were signed with General Aviation, Inc. which manages the privately owned field. With the agreement assuring a regular yearly income to the field, General Aviation has negotiated a bank loan to cover the cost of field improvements.

Cessna 180 to Carry Writer Halfway Around the World

Wichita, Kansas. Lowell Thomas, Jr. and Mrs. Thomas recently took delivery of a new Cessna 180 which will take them on an extended trip nearly halfway around the world. The Cessna 180 is being packaged and shipped by boat to France where it will be re-assembled and used as a means of transportation for a trip through the Continent into the Near and Far East. The Thomas' aerial route will take them through southern France, to Spain, to French Morocco, to east coast of Africa, through French West Africa and then on to the Belgian Congo, to British East Africa and to Egypt.

TOP FLIGHT—*When George Pew (left), Chairman of Board of Aero Design & Engr., had Lear L-5 and coupler installed in his Commander, Bill Lear detailed the operation*

Mr. Thomas will be writing a series of articles for *Reader's Digest* and the *American Weekly* on the events and experiences of the trip.

Jet Boosters on Company DC-3 Permit Short-Field Operations

Toulouse, France. After considerable engineering and test work, two *Palas* auxiliary jet units were installed on a company DC-3 to permit short-field operations. The DC-3 is owned by Jacques Violet of the J & S Violet Sons, a concern which produces and sells wine and an apertif known as Byrrh.

The company has used aircraft for business since 1934 when it employed a Morane-Saulnier MS-237 to acquaint the public with its products by taking first-flighters aloft. The method of publicity was curtailed by the war, but in 1952 it was resumed and an eight-place twin-engine de Havilland *Dragon Rapide* was pressed into service in the Lyon region. This operation was so successful in familiarizing people with J & S Violet Sons' products that Mr. Violet decided to put his own personal DC-3 at the disposal of his company's publicity department.

Originally fitted to seat seven, the DC-3 was converted to seat 28 passengers, and the two *Palas* units were installed by SNCASO to enable the aircraft to operate out of small airports. During these first-flighter operations, the plane flies an eight-hour day five days a week, making three flights per hour and carrying some 2500 people per week on initial hops.

Instrument panel of the DC-3 was especially designed by SNCASO, but the aircraft's navigational instruments, etc., are standard airline types. Pilot of the DC-3 is Jacques Meyer, a former airline pilot. A flight mechanic and a raidoman make up the remainder of the crew. The plane is based at Toulouse.

PALAS *units, one under each wing, were installed on DC-3 for extra performance*

....in the Business Hangar

International Business Machines' Aero *Commander* has been in the Aero Design and Engineering Co. shop at Bethany, Oklahoma for installation of a Flite-Tronics MB-3 marker beacon receiver.

Ralph A. Nellson of the Nellson Telephone Directory Advertising Service, Inc., of Rochester, N.Y., has had his Cessna 170 in the Roscoe Turner Aeronautical Corp. hangar at Indianapolis for installation of a Javelin Auto-pilot.

Mather Iron Company of Cleveland appointed Flight Safety, Inc., an organization headed by Al Ueltschi, chief executive pilot for Pan American Airways, to recommend an executive aircraft. Selected from competitive specifications was a Remmert-Werner DC-3 which features SAE instrumentation and lighting, Collins VHF communications, omni, RMI, ILS, Sperry C-2 gyrosyn compass and H-5 electric gyro horizon, Bendix marker beacon and ADF, ARC Isolation Amplification and speakers, plus one-piece birdproof windshield, extra large cabin windows and three extra large picture windows.

Trusdale Construction Company's Twin-Beech was in the shop at Southwest Airmotive for minor repairs. The plane is based in California and is flown by R. J. MacDougall.

Westinghouse Electric's chief pilot, A. C. Korb, has been at Pacific Airmotive in Burbank, while his company's *Lodestar* underwent 1,000-hour inspection, complete electrical re-wiring, hydraulic system overhaul and new radio installation. Korb is regularly based at Allegheny County Airport, Pittsburgh.

One of Sears, Roebuck and Company's DC-3's has been at AiResearch Aviation Service, Los Angeles, for new engine installation, an A-12 autopilot and new one-piece windshield.

Consolidated Western Steel Corp., of Houston, Texas, has added a Flite-Tronics MB-3 marker beacon receiver to the company's D18S. Installation was made by J. D. Reed Co., Inc.

Roy Black, pilot for the Studebaker Corp., and his copilot, Don Westfall, recently made a return visit to Roscoe Turner Aeronautical Corp. in their blue-and-white DC-3. Credit for the original paint design belongs to Raymond Lowey, although the work itself was done at Roscoe Turner Aeronautical's hangar.

Renwar Oil Corporation's *Lodestar* has been in the Southwest Airmotive shop for prop overhaul and other repairs. Pilot of the *Lodestar* is R. H. Barker.

Thompson Products is now flying its DC-3 after completion of a new executive interior, installation of additional radio, large baggage door and two picture windows. Work was done by AiResearch Aviation Service at Los Angeles. Thompson Products, Inc., of Cleveland, Ohio, is a member of NBAA.

Bethlehem Steel's *Lodestar* is at Pacific Airmotive for a new interior by Aero Interiors, Inc. Al Junkers, chief pilot, regularly bases the *Lodestar* at Allentown Airport, Allentown, Pa. Mr. Junker and L. J. Koons, also a Bethlehem Steel pilot, are the company's NBAA representatives.

Grumman Aircraft is flying a new Super-92 DC-3 from Remmert-Werner. In addition to the Super-92 engines, the DC-3 features extra large cabin windows and three large picture windows, plus a Sperry A-12 autopilot, Collins VHF communications, omni and RMI.

Three business planes are in the hangar at AiResearch Aviation Service for installation of custom interiors. Two of the aircraft are Convair 340's, one owned by The Texas Company and the other by Union Carbide and Carbon Co., and the third plane is a Lockheed *Lodestar* owned by Texas Eastern Transmission Company, Shreveport, La. The two Convairs will also get exterior paint jobs and A-12 autopilots.

Official NBAA Report

NATIONAL BUSINESS AIRCRAFT ASSOCIATION, INC.

(formerly Corporation Aircraft Owners Association)

National Business Aircraft Association, Inc. is a non-profit organization designed to promote the aviation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable business aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. NBAA National Headquarters are located at 1701 K Street, N. W. Suite 204, Washington 6, D.C. Phone: National 8-0804.

NBAA'S 1954 Annual Meeting To Be Held In Dallas, Texas

Dallas has been selected as the site for the seventh annual meeting and forum of the National Business Aircraft Association to be held on October 27-29, 1954. Convention headquarters will be the Hotel Adolphus. The Board of Directors plan a two and one-half day program, and it is tentatively proposed to devote most of the program to membership problems, with fewer formal speeches. NBAA annual awards are to be made during the forum. Details of the meeting will be carried in a subsequent NBAA Report. Al Harting, Director of Public Relations and Secretary of NBAA member Southwest Airmotive Co., has been named chairman of the arrangements.

Business-Aircraft Operator Groups Formed By NBAA

For a number of months, NBAA has been assisting in the formation of Business Aircraft Operator Groups primarily in the Eastern United States under the sponsorship of the National Technical Committee. It is the belief of our Board of Directors that in areas where there is heavy concentration of business-aircraft operators, many problems arise in connection with day-to-day ground and flight activities which could be more easily resolved by discussion with other operators who may be confronted with similar problems or have found workable solutions.

By exchanging opinions, operational data, and seeking the views of the CAA, Weather Bureau, and Airport Manager about local conditions, a healthy respect for each others' problems can be developed. The spirit of cooperation resulting from the formation of these groups will go a long way toward encouraging united action on business-flying matters.

Your Executive Director has attended meetings in Cincinnati, Toledo and Denver, and is planning to attend others in the near future. At these meetings, a part of the program is devoted to telling the groups about NBAA services and activities at the national level on behalf of members and all business aircraft operators.

Following is a breakdown of District Representatives of NBAA as of the end of January:

WESTERN UNITED STATES—Chairman, Richard W. Lane
Asst. "Scotty" Miller,

**SAN FRANCISCO-SAN JOSE—Richard W. Lane, Chief Pilot, Food Machinery & Chemical Co., 333 West Julian Street, San Jose, Calif.
"Scotty" Miller, AirResearch Aviation Service, Inc., Los Angeles International Airport, Los Angeles, Calif.

**SAN ANTONIO—George W. Vaughan, Chief Pilot, Phillips Drilling Corp. 306 Milam Building, San Antonio, Texas

**DENVER—Forest R. Conover, Chief Pilot, Ideal Cement Co., 500 Denver National Building, Denver 2, Colo.

EASTERN UNITED STATES—Chairman: Walter C. Pague

*CHICAGO—J. V. Swanson, Chief Pilot, Sears, Roebuck & Co. 525 So. Homan, Chicago 7, Illinois
Asst. Raoul Castro, Pilot, International Harvester Co., 180 No. Michigan Avenue, Chicago, Illinois

*CINCINNATI-DAYTON—W. C. Pague, Chief Pilot, ARMCO Steel Corporation, 703 Curtis Street, Middletown, Ohio
Asst. Nelson U. Rokes, Chief Pilot, Proctor & Gamble Co. Lunken Airport, Cincinnati 26, Ohio

*CLEVELAND—Robert E. Sheriff, Chief Pilot, Thompson Products, Inc. Sky Tech Hangar, Cleveland-Hopkins Airport, Cleveland, Ohio

*DETROIT—Robert J. Kusse, Chief Pilot Fruehauf Trailer Co., 10940 Harper, Detroit, Michigan

MILWAUKEE—Tom R. Neyland, Chief Pilot, Albert Trostel & Sons, Co., 1776 North Commerce Street, Milwaukee 1, Wisc.

**NEW YORK—John L. Lee, Vice Pres., Red Devil Tools, 130 Coit Street, Irvington, New Jersey

*PITTSBURGH—Al Litzenberger, Chief Pilot, Mesta Machine Co., Allegheny County Airport, Dravosburg, Pa.

*TOLEDO—C. Tracy Service, Chief Pilot, Libbey-Owens-Ford Glass Co., Nicholas Building, Toledo 1, Ohio

BRIDGEPORT—Wm. E. Shaughnessy, Jr., Chief Pilot, American Cyanamid Co., Hangar #2 Bridgeport Airport, Stratford, Conn.

* CAA Representative

** CAA Representative and State Representative

The Mississippi River is the dividing line between the Western and Eastern Sections.

It is important to point out that many members of the groups formed are not in NBAA. It was our primary aim to encourage *all* business-aircraft operators in various areas to meet for the express purpose of interchanging information, working together on mutual problems, and presenting a united front, whenever required, for business flying in the area.

Flight Safety Committee Established By NBAA

National Business Aircraft Association has established a Flight Safety Program Committee to study all business aircraft safety phases, including pilot proficiency training, establishment of flight safety standards, compilation of accident reports, and near-accident analysis. Standards and tests for the selection of business-aircraft pilots also will be set up. William R. (Rip) Strong, Chief Pilot for National Dairy Products of New York, has been named Chairman. The committee will be under the direction of the National Technical Committee, headed by Ralph E. Piper, Chief Pilot of Monsanto Chemical Co. of St. Louis.

New NBAA Members

1. Eastman Oil Well Survey Company, Denver, Colorado. NBAA Representative—Robert C. Van Buskirk, Chief Pilot. Company operates Lockheed *Lodestar*
2. Ray-O-Vac Company, Madison, Wisconsin. NBAA Representative—O. B. Wynn, Manager Airplane Operations. Company operates Aero *Commander.*
3. The Rust Engineering Company, Pittsburgh, Pa. NBAA Representative—Bernard Young—Chief Pilot. Company operates Beechcraft D-18-S
4. Shepherd Tractor & Equipment Company, Los Angeles, California. NBAA Representative—W. W. Shepherd, Pres. Company operates Beech *Bonanza,* Piper *Tri-Pacer,* Republic *Sea Bee.*
5. E .T. Barwick Mills, Chamblee, Georgia. NBAA Representative—Carl C. Forrester, Jr., Chief Pilot. Company operates Lockheed *Lodestar*
6. Jeppesen & Company, Denver, Colorado. NBAA Representative—E. B. Jeppesen, President
7. Southwest Airmotive Company, Dallas, Texas. NBAA Representative—Earl E. Webb, Service Rep.
8. Southern Flight Service, Inc., Charlotte, North Carolina. NBAA Representative—Richard R. Washburn—President. Company operates Beech C-18-S, Beech *Bonanza.*
9. Macweir Coal Company, Chicago, Illinois. NBAA Representative—David H. McMaster, President. Company operates Cessna 195-B

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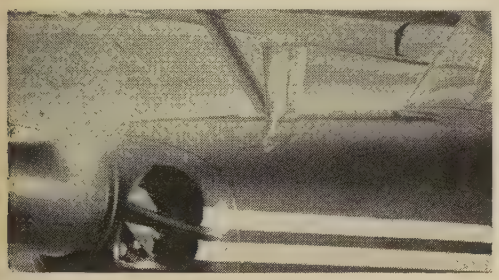

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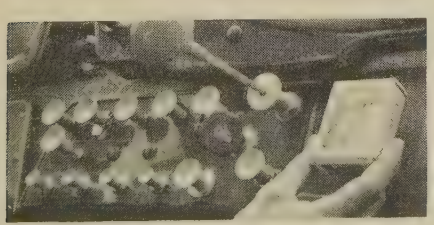

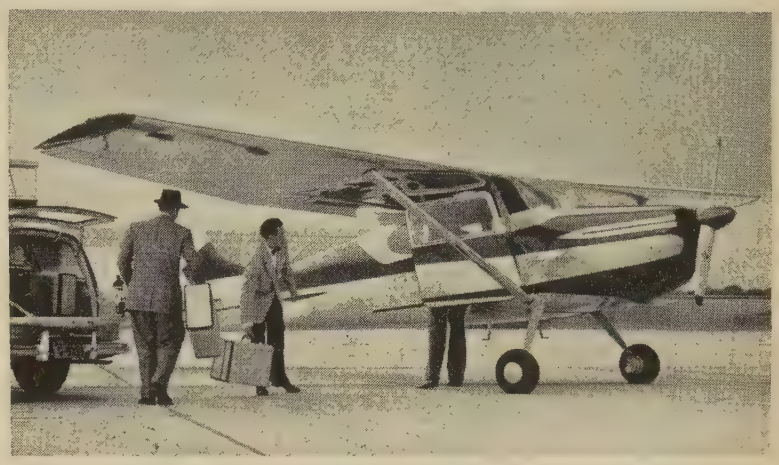

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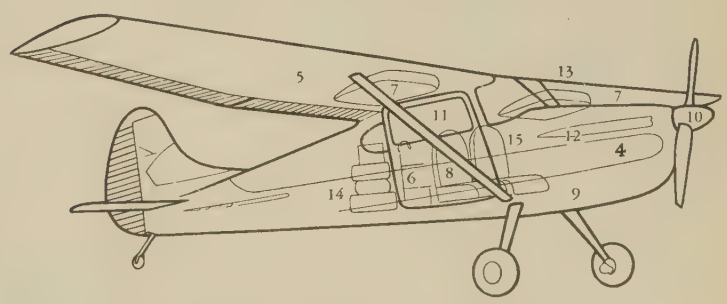

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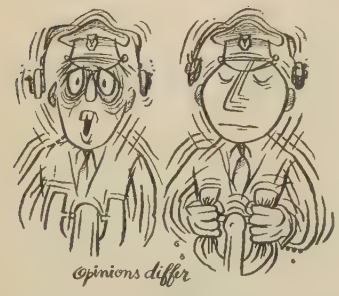
4 GREAT CESSNAS 170 180 195 310 THE COMPLETE AIR FLEET FOR EVERY BUSINESS NEED

Performance PITFALLS

from the Files of the Flight Safety Foundation

by Jerome Lederer and Robert Osborn



REPORTING TURBULENCE

Even though pilots recognize the significance of turbulence to safety and comfort, many of them admit considerable hesitation in reporting it. Among the reasons are these:

1. Pilot is afraid of establishing an "alarmist" reputation for himself.
2. Definition of terms "moderate," "severe," etc. is subject to opinion and may vary from pilot to pilot.
3. Turbulence may be very local, probably missed by other aircraft flying through the area, hence a report may cause unnecessary concern or diversion by other pilots.

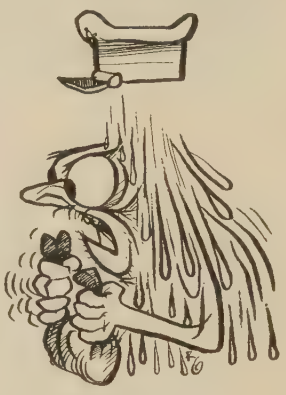
As far as a definition of turbulence is concerned, here is one suggestion:

Light—when it scares the passengers.

Moderate—when it scares the stewardess.
Severe—when it scares the pilots!

Seriously, however, the following terminology regarding degree of turbulence is used by flight personnel of a large airline in describing actual or expected conditions of turbulence.

1. *Smooth*—The condition of the atmosphere is such that no turbulence at all exists; in other words, the flight is expected to be perfectly smooth.
2. *Choppy*—Turbulence of no consequence. It causes slight irregular movement ot the aircraft and, over a long period of time, might cause passenger airsickness. It does not appreciably alter the performance of the aircraft.
3. *Light Turbulence*—A turbulent condition through which an aircraft may be flown indefinitely. It does not seriously affect the aircraft. Passengers may be required to use seat belts, but objects resting in the airplane remain at rest.
4. *Moderate Turbulence*—A turbulent condition in which an aircraft may be flown without serious difficulty. A long flight in moderate turbulence may be inadvisable. In general, moderate turbulence requires that airspeed be reduced. Passengers require seat belts and occasionally are thrown against the belt. Unsecured objects move about.
5. *Severe (or Heavy) Turbulence*—A turbulent condition in which the aircraft may momentarily be out of control. Passengers are thrown violently into the belt and back into the seat. Objects not secured in the aircraft are tossed about.
6. *Violent Turbulence*—A turbulent condition so violent that the aircraft may suffer structural damage. Pilot has little or no control over the aircraft.

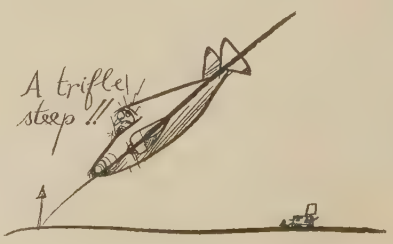


GLIDE SLOPE INDICATIONS

A recent pilot comment indicates that you should again be reminded that glide slope needle and flag indications may be obtained when certain VOR frequencies are selected. In VHF NAV (VOR) receiver-equipped aircraft, the proper glide slope receiver frequency is automatically selected when the VHF NAV frequency selector is set to any of 12 localizer frequencies. It just happens that the selector design is such that glide slope frequencies are also selected when certain VOR frequencies are selected.

As an example, the glide slope frequency paired with localizer frequencies 109.9 and 111.9 is selected when VOR frequencies 113.9, 115.9 and 117.9 are selected, and if there is an ILS operating on 109.9 or 111.9 in the vicinity where you are flying while tuned to a VOR on 113.9, 115.9 or 117.9, glide slope indications will be received.

Watch this in the Chicago Midway Airport area.



ACCIDENT REPORTS

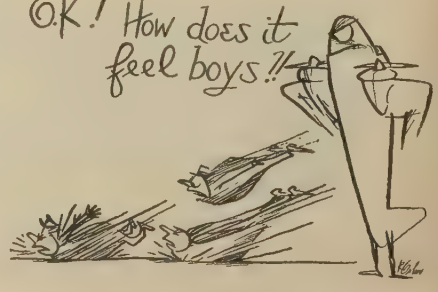
The following mishaps indicate that the old bugaboo "pilot error" continues to needlessly pile up aircraft.

Corpus Christi, Texas: After passengers had boarded a *Lodestar*, the pilot started the engines. While the copilot was trying to close the cabin door (and having some difficulty doing it), the pilot started to taxi out and turned the plane slightly to the right. The *Lodestar's* right prop struck the tail section of a *Bonanza* parked to the right and parallel to the *Lodestar*. Result: complete destruction of the empennage and fuselage aft of the *Bonaza's* door. Cause: Haste makes waste.

Monmouth, Illinois: The landing gear of a Bonanza collapsed during landing and the aircraft slid to a stop on its belly. Evidence indicated the gear was not fully down and locked, believed due to malfunction of the electrical system. However, it also appeared that the pilot failed to check the visual gear-position indicator. He just assumed the gear was down when he heard the electric gear motor running.

Wheeling, Illinois: Just before a Twin-Beech became airborne on take-off, its landing gear retracted. The pilot reported that after the accident, he found the gear switch in the "up" position. The assist in this double play was the fact that the landing gear switch on the Twin Beech is located below the throttle quadrant.

San Francisco, California: Pilot, copilot and one passenger aboard a company B-26 were coming in for a landing at Mills Field. Everything was fine. . . . except that the pilot failed to lower the landing gear!



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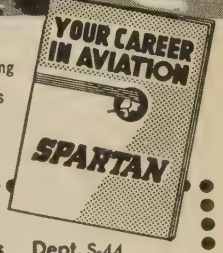

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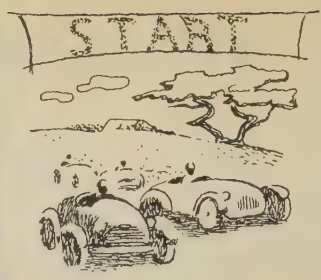
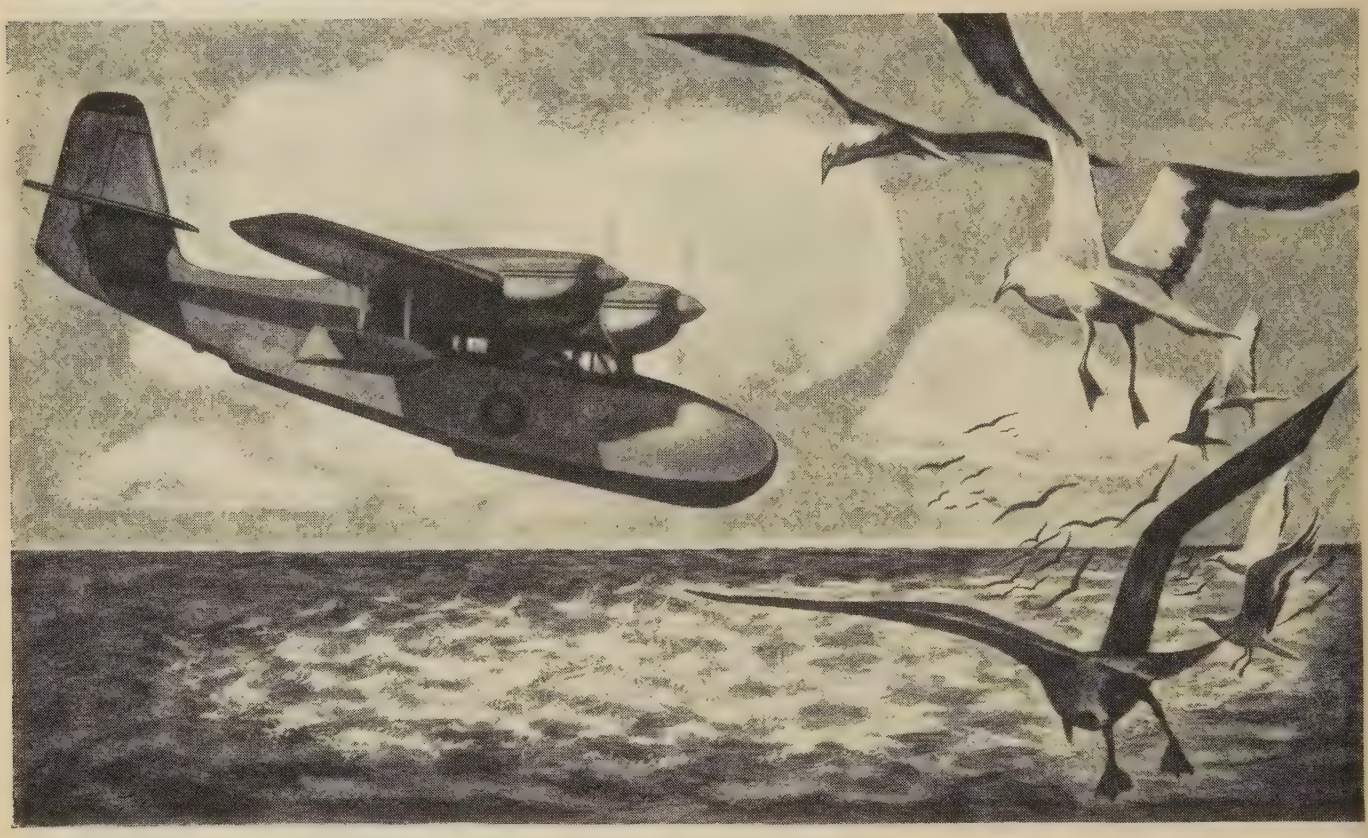


Your Best Week-end Flight Plan for April

Fly to Monterey, Calif., for the annual Pebble Beach Road Races, April 10 and 11. Plan to land at Monterey Peninsula Airport for quality Standard Aviation products and service.



The flying eyes of the tuna fleet

Scouting for tuna! That's W. H. "Hank" Coffin's job every spring, when the tuna start up the Mexican coast. From Whiteman Airpark, Pacoima, California, he flies to Ensenada, where he takes off at dawn to search for the seagulls that fly above the huge schools. He lets down from 5000 to 50 feet to make sure the fish are tuna, then radios his position to the waiting "clipper" boats.

"It's fun to fly low over a sea that's churning with tuna, just as long as I can depend on my plane and its engines," says Mr. Coffin. "I always use *new* RPM Aviation Oil to keep my engines in top running condition—it gives me more safe flying hours. It stops pre-ignition and rough running that's sometimes caused by ordinary compounded oils, and it keeps engines clean of carbon and sludge. With *new* 'RPM', I've been getting 200 extra hours between overhauls.

"I make my ocean flying safer, too, by using Chevron Aviation Gasoline 80/87. It gives me plenty of extra power when I need it, and it's ended the trouble I had with fouled spark plugs when I used gasolines with higher lead content. It leans down for economy, too, at cruising speed."

T.M.'S "RPM", "CHEVRON," REG. U.S. PAT. OFF.

TIP OF THE MONTH

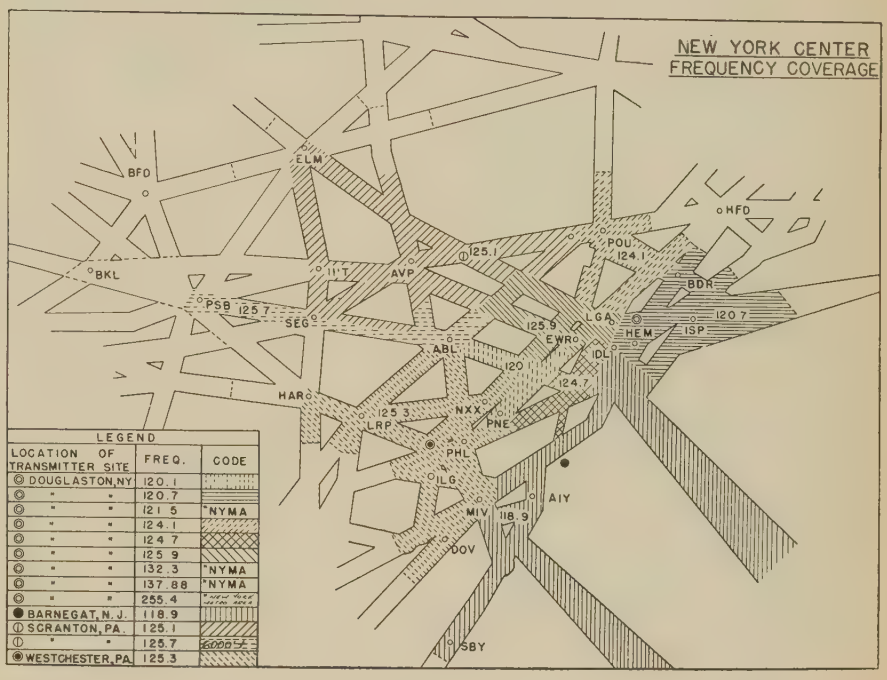
It's always a good idea to check your tires before take-off. If one tire is softer than the other, it can cause a ground-loop when you land.

CHEVRON AVIATION GASOLINE
NEW RPM AVIATION OIL
STANDARD OIL COMPANY OF CALIFORNIA

Direct Pilot-to-Center Communications Coverage

The attached chart represents pictorially the frequency coverage used by the N. Y. Air Route Traffic Control Center for direct communications with pilots operating IFR. Once again, it is worth stressing that the ability of the pilot to establish a direct link with the Center on these frequencies will have a direct affect on the ease and and rapidity with which he will obtain an arriving or departing clearance.

Note that the emergency frequency 121.5 mc (in addition to the military frequencies) covers the entire metropolitan area. Also, it should be known that radio communications being what they are, a pilot unable to establish or maintain direct contact on the frequency assigned in his last clearance, should try one of the other frequencies listed, as well as the emergency frequency before resorting to the time-consuming expedient of INSAC or range voice alternate relaying of communications.



Victor Airways Transition Eased

In the progress of transition from the LF to the VHF system, there will be many moments of anguish before the process is completed. Until recently, many pilots who filed via VHF facilities, after considerable expense and effort to equip themselves at the urging of the Great White Father in Washington, could be heard moaning loud and often at being cleared wholly via the old, well-beaten LF paths of the sky.

In previous *Navicoms* we have touched on the problems besetting the airways mathematicians, magicians or charlatans (according to your preference and experience!) when trying to clear flights via VHF airways that were in conflict with heavily used LF airways. (In our serialized feature, the Common System, the plans for the VHF airways system were related as set forth originally, and for eventual operation. There has been little change.)

One of the most crippling aspects of the transition problem has been the sole use of VOR facilities when commissioning Victor airways and routes. Already being tried out in practical operation, we now have routings being issued to aircraft filing VHF that are composed in part of LF facilities and airways. Intersections formed by LF range courses and ILS Localizer course extensions are becoming common, as well as employment in like manner of the fast disappearing VAR's.

Many a complaint has been leveled at the fact that widespread VOR facilities in mountainous areas have imposed such high minimum altitudes for assured radio reception that desirable lower altitudes above the minimum safe terrain clearance altitudes are made unavailable, complicating both flight problems and traffic congestion. In many locations, it is planned to resolve this difficulty by locating an LF facility (usually the comparatively low-cost and simple MH radio beacon) near the halfway point between such distant VOR's where a VOR facility is lacking for either technical or budget reasons.

By designating the Victor airway to include an LF facility at the intersection of the enroute radials from two successive VOR's, its use by both high-altitude and low-altitude aircraft is assured. Until their elimination by conversion or replacement, the VAR's (Visual-Aural Range) will be similarly employed to fill out vacant stretches in an otherwise little-used Victor airways. In this respect, it will be up to the pilot to advise of his inability to comply with a clearance specifying such routings.

As indicated on instrument and other charts, Victor airways consist of main and alternate routes, 10 miles wide. Predominantly north-south routes are designated by odd numbers, and predominantly east-west routes by even numbers. The main routes consist of the navigable airspace five miles on either side of the radials comprising the shortest practical course between two VOR stations. Although Victor airways frequently follow in some similarity the older LF routes that were dictated by terrain considerations, this will no longer be so, except to afford a comparatively "low altitude" routing. Aircraft capable of operation at altitudes well above any terrain or radio reception consideration, will find more direct routes, subject only to distance and facility availability.

In congested terminal areas, the problem of transition to and from Victor airways is already being resolved by the employment of ILS, TVOR and Compass Locator stations for routing and departure purposes far

beyond their original intention as instrument approach aids. Thus, the use of radials to and from the nearest enroute airway VOR to feed and accept traffic from terminal approach facilities has opened up multiple routings unavailable via purely LF facilities—and potentially confusing if multiple radials of a VOR are employed.

In the latter respect, both the government agencies and operators have been questioning the acceptance of the plus and minus 6° system error inherent in VOR operation; and for separation purpose, it is probable that individual study will have to be made of each area or route where potential traffic conflict appears possible.

Highly commendable and indicative of the new approach of the airways personnel to these problems is the strong move that is afoot to simplify airway route structures and to avoid designation of multiple airways in terminal areas where the result would detract from the usefulness of the main airway system.

The use of holding patterns employing VOR stations or intersections with minimum separation from other holding patterns may be somewhat hampered by a pilot's reluctance to rely on the 6° system error thesis where there is no regulation enforcing periodic accuracy checking of airborne receivers. Current reliance is on pilot attitude toward this important check.

Alternate routings, primarily for the purpose of traffic control (to climb or descend aircraft through altitudes of other aircraft, etc.) consist of the air space five miles either side of radials forming a secondary or indirect routing between two VOR stations. Normally, these and other designated courses to and from any VOR station will have a minimum of 15° angular separation.

And, in the instance of airway intersections formed by the crossing of courses from two VOR's, a minimum of 40° is desired, although in many parts of the country this has already been found impractical and a lesser angular convergence has been approved.

It already has been found practical to employ intersecting radials from VOR's located off the airway being flown for position-reporting purposes. It has saved time by eliminating the long delays from having to wait for "over" reports. Thus, on a long airway segment altitude changes can be accomplished when aircraft traveling in opposite directions report crossing the same intersecting radial.

Enroute and parallel Victor airways and/or Victor and LF airways that do not overlap at their edges are considered as having adequate horizontal separation for traffic separation at the same altitude or for climbing and descending. Even if the edges do overlap, but the center lines of the course of both the LF and the VHF airway are at least eight miles apart, it is sufficient if the pilot on the LF airway is operating on the side away from the VHF airway.

Further simplification of the VHF airway route structure may be expected prior to full employment, inasmuch as it is possible to redesignate heavily traveled routes by primary numbers regardless of course deviations imposed by air-space congestion problems. These changes can be accomplished better now, while usage by the flying public is at a low point.

Thus, the keynote of the present emphasis in agency offices across the country is simplicity in the planning of the VHF airway system so that the final transition, expected in a few years, will not only permit maximum utilization but the least difficulty to pilots and airways personnel. All efforts are being made with industry consultation and assistance to avoid repetition of the spaghetti-like mess of LF airways in congested areas that, like Topsy, "just growed"!

Air-Aids Spotlight

AUSTIN, Tex.: *ILS Outer Marker Comlo is 353 kc. New chart due.*

ARCATA, Cal.: *Interesting experiment with rotating hi-intensity lights on final approach after the midle marker at 2100' and 1000' respectively from Runway 31 threshold.*

DAYTON, O.: *New Air Force homing beacon on 325 kc, ident—"CVV", not CAA navigational facility. Located at Clifton Fan Marker site.*

LANSING, Mich.: *Interference problem partially solved by frequency changes. Tower still on 245 kc, LMM on 219 kc and LOM now on 254 kc; note distinction when tuning ADF.*

MOUNTAIN VIEW, *(Navy Moffett) Cal.: Low-frequency range "NUQ" to be on 379 kc; old HW facility frequency at FARALLON ISLAND outer holding pattern facility west of the Golden Gate now 314 kc.*

NEW YORK: LaGuardia—*121.7 mc. for ground control is possibility at this airport to eliminate conflict and potentially hazardous over-ride of transmissions on same frequency from Idlewild and Teterboro and vice versa.*

OKLAHOMA-TEXAS *area: Airways realignment second only to the recent Pittsburgh changes results in following:*

FORT WORTH *north course now 165° inbound, and OKE CITY south course 344° straightens Amber 4 and saves 7 miles. East course of OKE CITY to 271° and southwest course of TULSA to 039° routes this portion of Amber 4 around TINKER AFB instead of directly over it (NEWALLA and OKE CITY Fan Markers decommissioned). Finally, the re-alignment of TINKER LFR south course to 341° and designation of Blue 5 via the ARDMORE H beacon and Omni to the north course of DALLAS provides the much-needed dual airways in this area. See your charts for associated fixes and holding patterns.*

PITTSBURGH, Pa.: *In case you missed it, The ILS Outer Comlo serving Runway 32 at Greater PIT is now called* UNION *(ident—"UNE" on 201 kc) and the Outer Comlo serving Runway 28 is now called* RIVER— *(ident—"RER" on 323 kc)!*

NORWICH, Conn.: *The new VORW commissioned on 117.9 mc, ident—"ORW", (267° and 29 miles from the PROVIDENCE LF Range) fills the gap on the VHF BOSTON-NEW YORK airways left by the loss of the MOOSUP VAR. The NANTUCKET VOR planned may soon sound the beginning of the end for the heavily travelled LF airways in this sector.*

New Radio Handbook Available from CAA

For some years, students of the advanced art of radio navigation and communication have had to resort to a number of assorted manufacturers' treatises on how to use their equipment or on scattered and unrelated government bulletins. The only comprehensive government work on the subject was an outmoded handbook

last revised during the war years.

With the publication (dated Sept. 1953 and just recently released) of CAA Technical Manual No. 102, "Pilot's Radio Handbook" (for sale at Gov't Printing Office, Washington 25, D. C. Price: 45 cents), both the experienced pilot seeking a refresher text and the student pilot-navigator have a fresh and up-to-date volume.

The book gives a simple, easy-to-understand explanation of the entire art of radio communication and navigation for aviation purposes. Everything is modernized in terms of good general and standard practices. The book touches on enroute radio procedures, flight assistance services, ATC procedures, navigation and position-fixing by both LF and VHF ranges. It also delves into the allocation of radio frequencies and their proper use, and offers a complete description of The Common System in terms of equipment, and ground and airborne applications. It closes with a discussion of the various aviation-radio publications that are available to the pilot, and their proper and complete usage.

A great deal of credit is due the author of the manual, Tom Dodson, of the CAA Office of Federal Airways, and to George E. South, of the Office of Aviation Safety who assisted Mr. Dodson. No matter how experienced the pilot, he is bound to enjoy reading this new manual.

Air Defense Network Can Aid Lost Aircraft

The latest copy of USAF & USN Radio Facility Charts, available through C & G offices, advises that *emergency* assistance to lost aircraft in range of the ADC Radar Network in either ADIZ or other areas, can be obtained *if* certain basic procedures are followed by the pilot. (*Note:* As in the instance of Radar Thunderstorm Warning service, it is expected that every attempt to make use of civilian facilities where such are known to be available should be exhausted, time permitting!)

If two-way radio is functioning, the pilot may request radar help via any CAA airways or airport facility. If not locally available, the request will be relayed. Or the lost pilot may initiate the standard distress call of "MAYDAY" or "PAN" on emergency frequency, specifying the need for radar assistance. He should listen for reply on the same frequency. If the radar facility does not pick up the call right away, other facilities will alert Radar, and a reply should be obtained in quick order.

If unable to transmit but the receiver is functioning all right, the pilot should tune to the standard emergency channel and initiate the following action:

Fly a *triangular* pattern, all turns to the *right*, with *two*-minute legs and *one-half needle-width* turns of 120° at each corner. Complete *at least two patterns* before resuming course. If radar contact is established, instructions will be received on the emergency channel which will confirm the situation, followed by navigation and other assistance as necessary.

If the pilot experiences total radio failure, as of electrical power, he should initiate the above *triangular* pattern, but *with all turns* to the *left!* If radar contact is established, a rescue aircraft will be dispatched to intercept the lost aircraft and to lead the plane to safety, if practicable.

Resumption of course will not cancel the procedure, unless the pilot becomes able to advise to this effect, as in the case of a malfunctioning radio resuming operation. Hence, if the pilot wishes to proceed with his own emergency action until intercepted, he may do so. The aircraft will be tracked as a distress aircraft from the point of initial contact.

Pilots employing the above procedures are asked to repeat it every 20 minutes if practicable, until contacted or intercepted. As radar is restricted to line-of-sight coverage, altitude should be considered and an emergency climb made (if possible) before or during procedure.

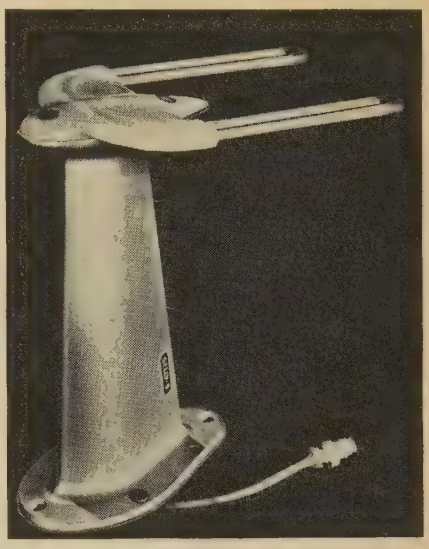
C-Band Radar Optimum for Weather Mapping

The results of the RCA-United Airlines program to develop a suitable airborne weather-mapping radar goes into high gear with the announcement of the choice of C-band.

Extensive testing, including studies by McGill University, lab development by RCA and flight tests by United Airlines, reveal that C-band radar is the optimum for this purpose. C-band radar will penetrate a minimum of 15 miles ahead of an aircraft, through a 60 mm-per-hour rainfall, using a transmitter power of 75 kw. According to J. R. Cunningham, UAL Director of Communications, this performance "cannot be duplicated practically by equipment operating on a higher frequency."

This is confirmed by the experience of meteorological groups with both X-band and S-band radar. Radar operating at frequencies above those of C-band may blank out or present misleading information in areas of moderately heavy rainfall.

Since storm formations cannot always be avoided, RCA points out, the penetration capabilities enable a pilot to follow paths of least turbulence, representing an important improvement in flight comfort, safety and dependability. It is expected that a reliable C-band radar can be offered to potential users with weight, size and cost factors comparable to those of other airborne radars.



Plastic Coat Improves Antenna Performance

Cavitation, shorting at high altitudes, conductivity leakage, fungus formation—all experienced as deficiencies in antenna performance under suggested conditions of extreme climate or altitude, are measurably reduced or eliminated by injection molding of a new plastic, "Kel-F" (tri-fluorochlorethylene polymer plastic) around antenna horns.

Produced by M. W. Kellogg Co., Jersey City, N. J., the actual molding process is done by the Auburn Button Works of Auburn, N. Y. High wind loads or the impact of airborne solids even at sub-zero temperatures will not stiffen or crack the plastic because of its high impact and compressive strength. Top performance in RF communication is maintained in spite of ice abrasion, thermal cycling and exposure to corrosive gases.

The high dielectric strength of "Kel-F" through thermal cycling and under high humidity prevents signal dissipation at ground level as well as in high-altitude flight. Under thermal cycling, the low thermal conductivity and expansion prevents separation of the shield from the antenna.

Electrical insulation of the antenna is enhanced by the smooth, non-porous and non-adhesive surface of the plastic shield.

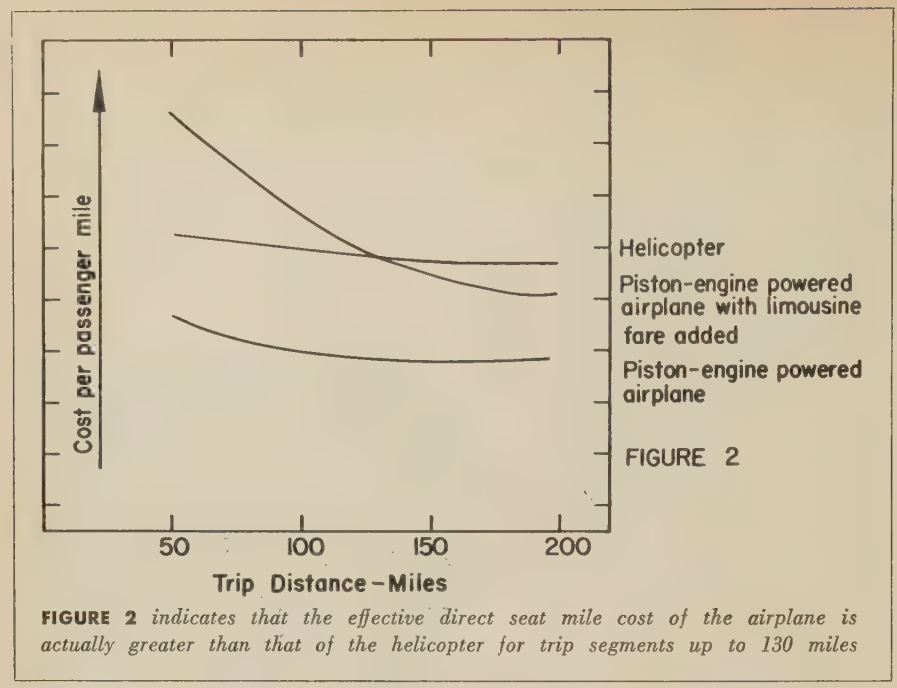


FIGURE 2

FIGURE 2 *indicates that the effective direct seat mile cost of the airplane is actually greater than that of the helicopter for trip segments up to 130 miles*

Trunk-Line Copter

(Continued from Page 21)

ments and refinements economical aspects will improve. Considering potential future developments, the helicopter should eventually be a major contender for short-haul trunk-line services, plus having the great advantage of offering more convenience for the traveler once adequate supporting facilities are developed.

In order to achieve its full potential usefulness, the future commercial helicopter must have the ability to operate reliably during weather minimums far below those presently applied to fixed-wing aircraft. The importance of this is apparent when one considers that fixed-wing aircraft presently lose substantial amounts of traffic, particularly on the shorter haul segments during the winter months when weather conditions are sometimes doubtful. Passengers may be willing to gamble a delay of a few hours on a long-haul flight, but many will not gamble on a short-haul flight if other means of transportation are available. It is particularly important for the helicopter to be able to operate at extremely low weather minimums so that its dependability for short-haul service will not be seriously questioned even in inclement weather conditions. This problem may be lessened somewhat because of the helicopter's extreme maneuverability, including hovering.

In many instances the helicopter will be landing among high buildings adjacent to heliports, the frequency of the demand for one-engine-out performance in the approach configuration may be greater than is true for a conventional airplane. Assuming the helicopter would have the same engine failure rate as some of the conventional airplanes and assuming good utilization and 400 landings per day at a single heliport, a one-engine-out landing would be made every five days. In the wintertime one of these landings out of seven would be made under ceiling conditions measuring less than 1200 feet in some localities. For fixed-wing aircraft a ceiling range of 800 to 1200 feet is not particularly critical with one engine out since the airplane would break out of the glide path at an altitude fairly well above all obstacles and sufficiently far from the runway threshold to allow both vertical and horizontal maneuvering. If heliports are located adjacent to high buildings, it should be remembered that breaking out of the overcast at 1,000 feet in a helicopter could be just about as critical as landing with a conventional airplane with about a 200-foot ceiling. In any event, the instrument landing system and the controllability of the helicopter in combination must be such that under one-engine-out conditions the helicopter would be capable of adequate handling by the average pilot.

All helicopter flights should be capable of safe landings after loss of power from one of the main powerplants. The airlines today cannot consider loss of power from one engine an emergency which involves serious question of flight safety. Neither can loss of a powerplant be considered an emergency in helicopter operation. Actually, operation must be planned against the remote contingency of single-engine failure so that the helicopter will still be able to execute a safe landing. This is quite possible today under favorable terrain conditions since loss of power in a fixed-wing airplane in no way diminishes its ability to fly or remain controllable, although range is affected rather abruptly. The auto-rotative ability of the helicopter should be kept strictly for real emergency use. This consideration, however, sets the stage for larger heliports than we perhaps first envisioned, since with normal design concepts, take-off would require forward speed to avoid flight regimes wherein auto-rotation could not provide safe landings. This whole phase of operations, however, must be considered subject to much further study and evolution.

While approaches to downtown heliports should be over open areas, such as rivers, parks and the like, a certain amount of flight over densely populated areas no doubt would be involved in some localities. Such aspects as these may call for more than ordinary consideration of performance margins and controllability with one engine inoperative. Certainly, such practical aspects as making the rotor blades invulnerable to bird strikes are a prerequisite to good design and must be accomplished, particularly considering the prevalence of birds in almost any metropolitan downtown area. Other practical aspects of this general character must be included in any sound commercial design.

The design of all rotor-blade assemblies and their attachments should be such that the possibility of having a failure which could cause loss of lift would be as remote as wing failure in fixed-wing type aircraft. This criteria has been accepted by the helicopter manufacturers, and experience indicates little cause for concern as long as proper inspection and maintenance procedures are indulged in.

It would seem desirable if a simple design could be evolved that would enable the pilot to fold the rotor blades on the ground by manual control from the cockpit without necessitating outside assistance by mechanical personnel. This would aid helicopter storage space problems but it would have to be most carefully designed to be fail-safe under all operating conditions.

It would also be necessary in the interest of passenger comfort that rotor-blade rotations not induce vibration impulses objectionable to the occupants at any rotational speed and under any flight configuration. In this respect it would seem appropriate to consider the development of counter-balance or dampening-type mechanisms to nullify the 1P vibrations apparent in most helicopters.

It would also appear prudent to apply the same good principles of design that have been applied to fixed-wing transport aircraft, such as not stowing fuel in the fusalage, providing independent fuel systems for each powerplant, providing complete fire protection and the like.

The wide speed range and universality of movement of the helicopter provides the need for special visibility considerations when laying out flight stations for transport helicopters. It is certainly advisable for the crew to be able to see in any direction in which the vehicle may be flying; yet, they cannot be poised in a transparent sphere in space. Certainly, however, the maximum visibility range, including direct rearward, upward and downward visibility, should be provided in addition to the usual visibility ranges found in fixed-wing aircraft.

For the same reason, it is necessary that the helicopters be seen, which calls for vastly improved external illumination over that in current use. Just how lights will be arranged to indicate true direction of flight of a helicopter is not clear, but the need does exist for establishing a standard.

In conclusion, let me say that, in my opinion, need exists for a machine having greater utility in the short-haul market; that the helicopter offers relatively early possibility of economically achieving this; and that with adequate ground facilities, truly superior trunk-line service can probably be offered in the future through the application of rotor-type aircraft.

. . . Take-Off

(Continued from Page 13)

day operations in restricted visibility as well as at night. Although runway center-line markings are the usual type, there are several variations of this, all of equal merit, at numerous airports throughout the country. The important feature is that the markings provide the pilot with continuous directional guidance which parallels the runway boundaries.

Although take-offs under conditions in which the ceiling and visibility are below certain limits are illegal for scheduled and irregular air carriers, the Administrator of Civil Aeronautics is not authorized to prescribe take-off minimums for other categories of air operations, such as the private and business aircraft. For all practical purposes executive and private pilots are permitted to establish their own level of safety in many phases of their operation—high, low, or intermediate—at their own discretion. The CAR's applicable to this phase of aviation are not as complete nor as rigid as those applicable to the air carrier.

What safety advantage is achieved through strict adherence to established take-off minimums? The hard and cold fact of the matter is that, although the limited visibility take-off in itself is not an unsurmountable problem, provision must be made for the aircraft to effect a safe landing should mechanical or other difficulties be experienced immediately after take-off. First, since zero/zero landings are not yet a daily routine, some weather margins on the take-off should be allowed to make possible the emergency landing. Second, the take-off roll must be made by visual reference to the runway for safety reasons; hence, it is necessary that some measure of surface visibility exist for this purpose. Obviously, all private and business operators should avail themselves of this safety factor in spite of the fact the CAR's do not make it mandatory. The facts in this paragraph do not apply to landing minimums. These minimums, published in the *Flight Information Manual*, are legally applicable to all civilian pilots.

Granting average good piloting technique, there is no instrument in wide use today, including the directional gyro and flux-gate compass, which can provide a pilot with adequate direction information to enable him to hold his aircraft within normal runway boundaries during take-off roll using cockpit reference only. Although the directional gyro and flux-gate compass do provide good course indication once the correct course has been established, they do not compensate for initial errors in aircraft alignment. These errors, even as low as one or two degrees, may be sufficient to cause the aircraft to leave the runway before being airborne if no other means of directional guidance is being utilized by the pilot. For example, an error of about 1° to the correct runway alignment will cause a DC-3 aircraft loaded to 25,200 pounds gross weight to veer off the edge of a 100-foot wide runway within the accelerate and stop distance of 3,330 feet at sea level. Errors in these amounts are very difficult to avoid if the initial run is guided solely by instruments

Consequently, the primary reference for restricted visibility take-offs is the runway center-line marking or its equivalent. This applies equally to both day and night take-offs. At night, runway lights, especially the high-intensity type, provide excellent secondary reference. Such lights should not be used as primary reference for low-visibility take-offs unless

(Continued on Page 32)

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Note to Dr. Watson, WHEREVER you are: Rosemary Payne is 22, 118 lbs., 5'7", with brown hair and eyes.

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. . . Take-Off

(Continued from Page 31)

spacing is 100 feet or less (customary spacing of runway lights is 200 feet). Immediately after breaking ground, it is imperative that the pilot make quick and positive transition to cockpit instruments for maintaining proper flight altitude thereafter. One of the very few exceptions to this would be in regard to take-offs of low-speed aircraft on runways of 10,000 feet or more in length in which advantage may be taken more readily of the surplus length for an emergency landing in the event of mechanical failure immediately after leaving the ground.

The availability of a take-off alternate airport is a fundamental requirement for any take-off when weather conditions are less than IFR take-off minimums. Normally, *Flight Information Manual* minimums for IFR take-off are 300-foot ceiling and 1 mile visibility; they may be higher at some airports due to local obstructions or other peculiar conditions. Such take-off alternates should meet the following qualifications:

1. Alternate should not be more than 15 minutes away from the point of departure at single-engine or one-engine-out cruising speed for aircraft involved.
2. If the take-off alternate is equipped with a usable radio let-down aid, reported weather may be as low as 1,000 feet and 1 mile.
3. If the alternate is not equipped with a radio let-down aid, reported weather should not be less than 2,000 and 3.
4. The terrain between the take-off point and the alternate should not be such as to require single-engine or an engine-out performance which exceeds that of the aircraft concerned at that particular gross weight.

NOTE: This take-off alternate airport should not be confused with the destination alternate airport which is required by CAR 60.42. This is recommended as a matter of additional safe operating practice, since it is not included in any part of the CAR.

It is believed that the policy expressed above should apply invariably when take-off is proposed in weather which is less than 300 and 1, or less than those minimums shown in the *Flight Information Manual*. It is advisable also that a take-off alternate be provided for weather conditions which may be better than this; however, the take-off alternate airport requirement need not be so restrictive. The scale for this is in the box above. (Radio let-down aid at point of departure is assumed.)

It is strongly recommended that, for departures from airports not equipped with any kind of usable radio let-down aid, the take-off alternate airport rules shown in the box apply whenever the ceiling is less than 1,000 feet or visibility is less than 1 mile at the point of departure.

With the limited performance of the single-engine aircraft when encountering mechanical trouble, pilots of such aircraft should not take off under any conditions in which ceiling is less than 300 feet or visibility less than 1 mile. Certain local conditions, particularly a scarcity of suitable fields for forced landings including mountainous terrain or heavily populated areas surrounding the airport, may make it desirable to have even higher absolute minimums for take-offs in single-engine aircraft.

The pilot should be certain that his aircraft is equipped with the appropriate ILS frequencies (including localizer and glide path pairing) if this is the aid involved. He should also be certain that he has the corresponding let-down plate in his manuals. Precision radar may be utilized, but it is well to make certain the air/ground radio equipment has the required frequencies. Radio navigation equipment in the aircraft should always be tuned to the frequency of the let-down aid prior to take off. When engine failure occurs on take-off under instrument conditions, there is little time for consultation with manuals and radio tuning.

There are certain extreme conditions which may confront a pilot proposing take-off in low visibility. These are:

1. High-altitude airports
2. High gross take-off weights
3. Limited runway length
4. Numerous obstructions surrounding the airport
5. Excessive humidity
6. High temperature

Any one of these, combined with low visibility, may make it desirable for safety reasons to postpone take-off. Most of these factors are of importance in any take-off, but their adverse effects, coupled with the problems of restricted visibility, may lead to hazardous operations.

To restrict one's aeronautical education to actual experience has been and can be costly. To profit by the thinking experiences of others is to exercise good judgment and flight planning. Summarizing:

1. Some weather margins must be provided at take-off to permit safe immediate landing should such be necessary due to mechanical failure, etc.
2. Primary reference for low-visibility take-offs (day or night) is the runway marking. Runway lights, especially the high-intensity type, are very good secondary references.
3. Serious consideration must be given to the type of weather causing the visibility restriction in deciding whether or not a safe take-off may be made.
4. Runway markings must be of such type as to provide the pilot with *continuous directional guidance* on take-off run.
5. Nearby alternate airports should always be provided in flight planning for departures under weather conditions which are less than the take-off minimums.
6. Availability of *usable* radio navigation aids should always be included in flight planning.
7. Extreme operating factors, such as high-altitude airports, high gross take-off weights, limited runway length, etc. should never be overlooked.

Take-Off Weather Condition	Take-Off Alternate Airport Requirement
1. Ceiling 300—600 feet, visibility less than 1 mile.	*Ceiling 800 feet, visibility 1 mile with radio aid; Ceiling 1500 feet, visibility 2 miles without radio aid.*
2. Ceiling 600—1,000 feet, visibility less than 1 mile.	*Weather not less than regular landing minimums as per* Flight Information Manual. *If no let-down aid, ceiling 1,000 feet, visibility 1 mile.*
3. Ceiling 300—1,000 feet, visibility more than 1 mile.	*Not required in flat, unobstructed terrain;* *Required in accordance with 2 above in mountainous or otherwise obstructed terrain.*

Shakedown Cruise

(Continued from Page 15)

ton tower advising: "Your traffic is a *Bonanza* practicing on the omni-range." With a hint of sarcasm the TWA pilot came back: "Do you know the exact position of that *Bonanza?*" To which the tower replied: "You tell him, 69V."

I may have sounded a bit smug as I intoned: "2769V is on a course of 170° to Dayton omni 18.3 miles out." There were a few moments of silence, then, from TWA in tones of wonder: "You got DME on that thing?" From then on, Mr. TWA didn't give a hoot about us. He knew where that *Bonanza* was, and he knew *it* knew where it was.

In many areas this was the first chance for local CAA station operators to try out the new equipment and they were eager to do so. In response to many of my queries, the answer was: "Can you hang around the area for 15 or 20 minutes? We want to send a man out to the station and it will take him that long to get there." I waited.

Once they'd become familiar with its basic operation, pilots who rode with me on check flights frequently came up with suggestions for new uses of DME. Mort Brown, chief of Cessna's flight department, watched the meter for a while, then announced: "Bet you could make a dogleg approach with this thing." He's right.

Take the theoretical (but very real) case of a large city with a large airport and the VOR/DME station on one side of town, and a large factory on the opposite side, next door to a handy small airport. An executive pilot is flying some businessmen to the factory but, when conditions are marginal, he has to land them at the large airport (rather than grope across the city in the murk) and let the passengers get back across town to the factory by car. But no more—not if he's using DME and omni. He can make a very effective approach to that little airport by taking an outbound radial from the VOR that will clear the congested area of the city. Then, at the proper distance from the VOR, he can turn into and bracket the circular orbit which will take him to the field. While he holds this curved course on his DME, he can re-set his omni to the cross-town radial of the airport and *really* pinpoint the place.

Everyone who became familiar with the operation of DME quickly recognized its great value in providing really accurate groundspeed checks, any time and in a hurry. The only added gear you need is a chronometer, which doesn't even have to be accurate (a minute is a minute, whether it's the right minute or not). Using the 0-20 scale of the DME, you can figure your groundspeed after flying a single mile along a VOR radial, while with the 0-200 scale you can get a groundspeed reading after 10 miles. I found it handy to carry a pre-computed conversion table and save arithmetic. A glance at the card told me that if I flew one mile in 24 seconds, I was making good 150 mph over the ground.

After making hundreds of groundspeed checks, I worked out a rule of thumb that is rough but seems reaonably accurate: You must be one mile out from the DME station for every thousand feet you are higher than the station elevation before you can get an accurate groundspeed check that doesn't confuse slant range and ground distance.

In connection with groundspeed checks, I became familiar with one use of DME that will have far-reaching operational value. The best the

(Continued on Page 34)

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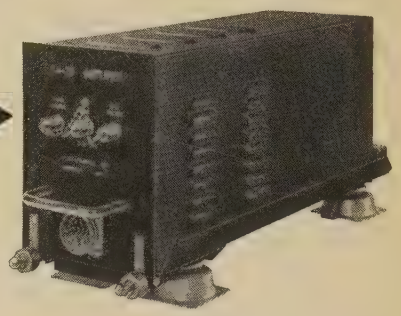

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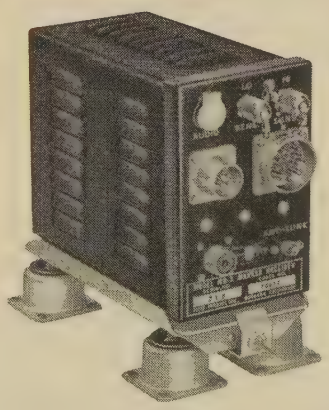

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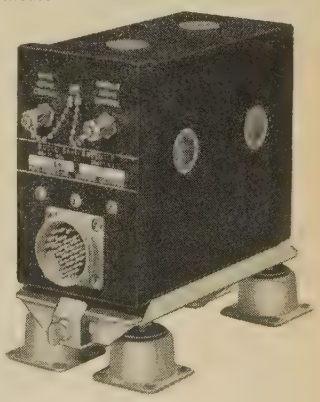

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Shakedown Cruise

(Continued from Page 33)

weather boys can do with winds aloft is an "analysis" based on information often several hours old. To get a cross-section of winds aloft using DME, I would take off and fly directly over the nearest omni/DME station. I'd establish the heading and course to my destination with the DME still tuned to the point of departure. Using a climb-out at a constant airspeed (rather than a constant rate of climb), I'd make a groundspeed check at every 1,000 feet. By the time I'd reached the end of the low-range scale, I knew the most favorable cruising altitude *at that moment and at that place* for the course I wanted to fly. I could re-check this any time I was within plus or minus 20 miles of any DME station.

The scientific pilots will appreciate the fact that this new ability to provide continuous distance indication leads to a knowledge of rate of change of distance, which is speed—groundspeed, under proper conditions of measurement. This ready availability of groundspeed is probably the biggest single benefit of DME.

We are accustomed to using dual omni or dual ADF in multi-engined aircraft. We dualize for convenience in triangulation or position-fixing, and obviously VOR/DME will provide better, faster position-fixing using the VOR/DME station as a single ground reference point. But we also dualize for reliability.

Omni alone provides good navigation through angular course information with which we are familiar. But DME alone gives us no courses, only distance, and it is less easy to see how distance alone will get us home. But it can—groundspeed is the key.

When your distance to a DME station is *decreasing* at a maximum rate, you can only be making good a course along a radial *to* that station. That makes sense, but even with DME it may be too tedious a procedure to take enough groundspeed checks to determine this maximum rate with sufficient accuracy to hit the station. So let's just take two or three quick checks and set up an approximate course toward the station. As we get close in, we will see the groundspeed drop off, if we are going to miss. Hold course until it drops to zero, when the miles meter shows minimum distance from the station. At this point the station is 90° to the left or right of our course. A simple maneuver (such as a 270° turn started just as the distance starts to increase again) will resolve the left-right ambiguity and permit us to set a course to cross the station. From there our heading (compass) and the distance will let us make an effective straight or orbital course to the field.

These random comments only serve to give a broad and general idea of the reliability and versatility of DME and the new sense of certainty it gives the pilot.

This long-awaited equipment is proving to be well worth the tremendous efforts of so many planners and designers during past years. I've seen enough to convince me that the months and years ahead will establish DME as a major factor in the attainment of simpler, safer flight.

EMERGENCY PROCEDURE USING DME ALONE

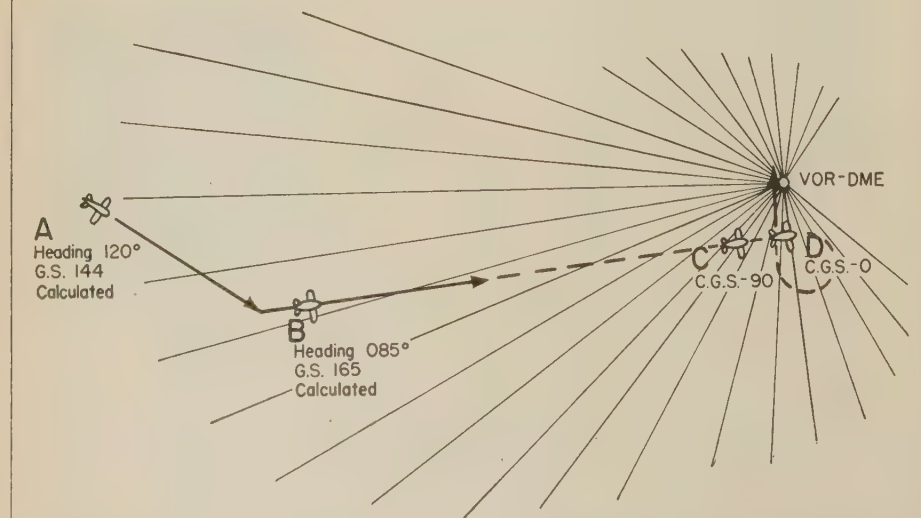

DIAGRAM *illustrates how a pilot, using Distance Measuring Equipment alone as an emergency procedure, can "go home" by a series of accurate groundspeed checks*

Skyways Round Table

(Continued from Page 19)

troversy in industry, and so the SAE set up a committee under the direction of Dan Beard of American Airlines, to bring about some sort of agreement. This committee did a magnificent job in bringing about a reasonable degree of standardization."

M. J. Johnson *(Pres., Johnson Aircraft Engineering Co.)*: "I certainly can sympathize with Mr. Reichel. He is given a set of specifications and he works out his data. Then he has his first mock-up inspections, but by the time he gets around to the fourth mock-up team, everything he did on the first go-round has been junked and he's had to start all over again.

"If there could be some concrete way of keeping the first thinking going through the whole project, up until you've built the first airplane, then you'd have a chance to get some things done by the time you've been asked to have them done."

LCdr. Hoover: *"Now let's have a look at this from an electronics standpoint. Mr. Raven, do you have similar difficulties?"*

Robert S. Raven *(Air Arm, Westinghouse Electric Co.)*: "We are equipment builders and so we do have the same problems of standardization. Personally, I think we want to be very careful that we don't go too far in standardizing."

LCdr. Hoover: *"Dr. McFarland, you've had to integrate information about the human in writing your two books. How do you feel about this?"*

Dr. Ross A. McFarland *(Harvard School of Public Health)*: "At the beginning of the war, one of our jobs was to study the effectiveness of a visual rangefinder. We did very elaborate studies with the rangefinder itself and we found that it was an instrument of great accuracy. We studied the characteristics of the human eye while ranging and we found that the human eye also was capable of great accuracy. However, we also found that when the eyes were used in the rangefinder, the margin of error was very great indeed. The equipment had not been designed for human use.

"It is obvious that the engineer wants to build something that will be effective when used. Therefore, how can he escape the responsibility of trying to find out something about human beings? The psychologist, the physiologist, or the physician, therefore, should come into the picture and try to present data which will be

useful in the effective integration of men and machines.

"I think it is obvious that we have reached the stage where, if we are to have effective combat weapons or safe and comfortable craft, we must try to introduce this concept at the design stage, or even before that. We must find out how the equipment is going to be used, for what purpose it is to be used, and then build the equipment around that need and the airmen who are going to use it.

"Just a word of caution—the human organism is extremely complex and it is hard to state simply in terms of linear scales the data which will represent the way an individual will react. One really needs nomograms in which one integrates a series of variables. It seems to me that there is a great need for research which attempts to integrate knowledge of the human organism with the requirements of weapons or other types of equipment in order to meet the human requirements of the operators."

A. W. Reichel: "At this stage I can't quite see where a manufacturing concern can go to get help in determining what these various parameters are for making the equipment more usable. At the present time I don't know of any agency or any group of people to whom the manufacturer could go and say, 'We've got a new bombing system, compass system, airspeed indicator or what-have-you. What is it the human being really wants?'

"Being engineers and not in the biological sciences, we're simply incapable of doing anything but make a good educated guess based on past experience. This guess may be right or wrong . . . we have no way of knowing. Is there anyone who can help us along these lines?"

LCdr. Hoover: *"Dr. Taylor is a good man to answer that because he recently completed a survey of human engineering facilities."*

Dr. Taylor: "I can't give you a good answer in the sense that I can name some central location where you could go and get your problems *solved*, but I can point out that there are several government agencies or sub-agencies which have laboratories doing work of various human engineering varieties and which should be able to give you some help.

"Also, there are industrial psychological organizations such as the one Dr. Berrien represents, and that one represented by Dr. Orlansky, which are glad to provide you with answers.

"This need for help is a very real

(Continued on Page 36)

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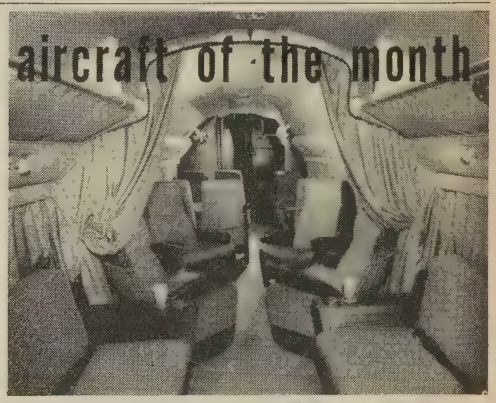

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Skyways Round Table

(Continued from Page 35)

problem, and one that can't be fully solved now, though I believe it will come to be met gradually on an evolutionary basis. The universities are beginning to teach this kind of engineering, and it will grow.

"The word is getting around . . . some of the word is good and some is bad, but ideas are being infused gradually into the industry. Handbooks are being put out. The Tufts College Handbook has been out for several years and is purchasable by aircraft companies. The Naval Electronics Laboratory has a handbook and it's a very good one. A revision of this is out now or will be soon and it can be purchased from the Navy. Also, the Joint Armed Services are putting out a handbook.

"Within the Navy there is a small new organization which is trying to act as a clearing house for this human engineering information. That organization is the Human Engineering Section in the Physiological Psychology Branch of the Office of Naval Research. Mr. Wohl is pretty much it right now, and if you'll take your Navy problems to him, he will try to get you some assistance."

Dr. Berrien: "I sympathize with the instrument manufacturer's problems in getting answers to specific questions. The human engineer has access, because of his interest, to certain kinds of information which ordinarily doesn't come to the desk of the engineer. Consequently, even though this information may not be complete, it can be of some use as a guide in certain kinds of problems.

"Aircraft engineers generally have gotten far ahead of the human and biological sciences. These engineers can do weird and wonderful things with equipment, and basic research in this field of human engineering simply has not come up to the level the current applications demand.

"Another problem arises from the fact that the human engineer is dealing with future results, future demands. We are actually trying to project ourselves some 5 or 10 years ahead, and we don't know what the operating conditions will be at that time. With military aircraft, for example, we don't know what the tactics are going to be 10 years from now.

Therefore, it seems to me, we have three problems: one, the sources the human engineer has are only good as guides; two, we don't know everything we ought to know because the basic research has not caught up; and three, we don't know what is going to be demanded of pilots henceforth."

Dr. Orlansky: "I, too, sympathize with Mr. Reichel's problem of having to change an instrument after he's started building it. As I interpret it, two issues are involved here. One is that certain elements of instrument design could be standardized right now. In general, this refers to such factors as letter size, scale marking, brightness, contrast, etc. Instrument design characteristics of this sort could be standardized almost immediately, and then you should not have the problem of changing dials.

"The other issue is the one of requirements. Our airplanes, we are finding out, can do new things, and we want our instruments to show new types of information. We must realistically face the fact that new requirements will come along and for that reason our instruments will have to change. It would be a mistake to standardize just for the sake of standardizing; though, of course, it may be necessary to accept momentary freezes to get into production.

"This leads us to hope that mock-up boards have a rational basis for establishing their requirements and for changing them, if necessary. I trust that one member's opinion, no matter how senior, is not the basis."

A. W. Reichel: "Dial markings are not our biggest worry . . . they are in effect standardized. However, whether or not a dial is necessary at all is the question that is being asked us today. I agree with you that at the present time such items are developmental. But, since this discussion is on human and also design engineering, it seems to me that the human engineer, even though he may not be 100% correct, should try to establish certain temporary parameters and keep them for a sufficient period of time so that development can be economically and reasonably performed."

M. J. Johnson: "We have a basic concept of what we want and this concept is given to the engineer to perform as a presentation. But when the presentation finally reaches the point of production, the original concept is suddenly changed, and the whole presentation is thrown out the window. Perhaps the original thought should be carried along to a state of completion, and the changes be made in the next model."

LCdr. Hoover: *"Do you think this would be eliminated in a large measure if human engineers had been available in the beginning?"*

M. J. Johnson: "I certainly do. If human engineers were available at the beginning of the development of an idea of presentation, then Mr.

Reichel's problem becomes much easier to handle . . . he can do a complete job."

Dr. McFarland: "How many of the services train men in this field and send those men to the manufacturing companies to follow up the requirements of their specifications? I dare say that if a well-trained scientist were to spend a year with Dr. Grether, he could teach him the principles of instrument design, and then if that person went to a manufacturing concern and participated in the mock-up stages of the aircraft, he would be able to carry out, on a practical or functional basis, the most effective use of that knowledge.

"Isn't this a step that needs to be carried out before we can really integrate these various fields or points of view we are discussing?"

M. J. Johnson: "That has been done with men in uniform, but I think Dr. Grether will agree that just about the time they get a man trained he disappears to some other tour of duty. Therefore, all the work he's done is wasted. We have no stability in that whole program."

Col. Talbot: "I think Mr. Johnson's view is a bit pessimistic. Speaking only for the Air Force, we have made some progress since the war in stabilizing personnel in the R&D business. It is quite true that people in uniform are much more susceptible to transfer than those who are not in uniform. However, we do have a very realistic program now of bringing people back to R&D even though they may have to do an operational tour for a time."

R. D. Blakeslee: "To me, a gap exists between the laboratory data we have and the actual operational experiences. There should be much more operational testing so that laboratory data can be translated into practical use."

LCdr. Hoover: *"That points out the second item I mentioned: the difficulty of applying research results."*

LCdr. Houston: "The difficulty of applying research results is not unique to the field of human engineering, for it is a problem that is present in most situations requiring the application of research findings. I don't know of any pat solution to the problem, but certainly the research must be properly designed for the results to be of practical use. The human engineer must work closely with the using agency in order to determine what the operational requirements are, and he must design and conduct his research in such a manner that the results will be of practical use to the engineer."

A. W. Reichel: I'd like to hear a few comments on Dr. King's proposal regarding some sort of a basic chart on what the human being can do."

LCdr. Hoover: *"Dr. Taylor, isn't this what the Joint Services Guide is supposed to do?"*

Dr. F. V. Taylor: "Yes, the Joint Services Guide is intended to provide principles to engineers in a form they can use.

"Relative to Mr. Reichel's statement, it may be that his request for a basic chart of human behavior is not quite the proper one to make. We have often been asked to furnish a 'human equation' to the designer of control loops in which men will be inserted. We realize it would be extremely desirable to have the engineer furnished with such a 'human equation.' However, the engineer must recognize that the man has as many equations as there are control systems into which you can insert him. Therefore, in this case, the proper thing is not to provide the engineer with a blueprint of everything that the man can do, but instead the human engineer should be asked what the man can do *best.*

(Continued on Page 38)

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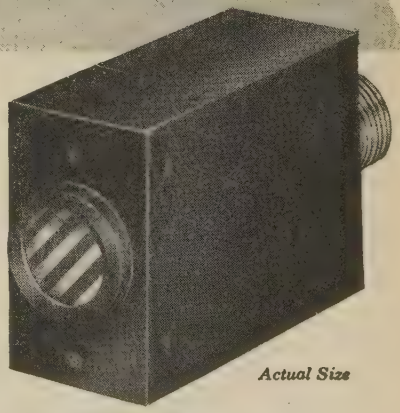

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Skyways Round Table

(Continued from Page 37)

"This is the sort of thing we can at least begin to answer now. The desire to know all about what all men can do in all situations is almost impossible to satisfy. But if you ask us what the man can do *best*, we can make some suggestions."

Capt. W. L. Smith *(Consultant):* "Gentlemen, I'd like to state first how useful I think such conferences as this are. Also, I'd like to point out that human engineering is not new in aviation. It started with the first airplane, where most of the problems had to be solved by trial-and-error methods. The questions of how to control the airplane and the best way to operate the controls had to be worked out by the very first men who flew. Airplanes are designed to fly through the air, and pilots are the ones who control the airplanes in the air. The pilot always has had to bridge the difference between the kind of an airplane he should have had and the one he actually had, with his own skill. We have had to help the pilot with that bridging by a training program. Pilot training plus pilot ability always has had to bridge that difference. We should pay tribute to the people who have done the training and to those who have developed the training methods and devices. These training devices, for example, the Link (*see cover*) and Curtiss-Wright Dehmel Simulators, make it possible to train pilots faster and easier, and that brings up the point I want to make. One of the ways to solve some of these human engineering problems is to use one of these training devices set up so that we can solve these problems by the old trial-and-error method. This is one practical way of resolving many arguments. Let us put one or more pilots in one of these trainers, give him various set-ups in succession, and determine to which one he reacts best. That will save a lot of cockpit mock-up time and expense."

LCdr. Hoover: *"Obviously, there are many problems confronting the manufacturers, and the human engineers claim they have methods of solving these problems. Dr. McFarland, would you care to comment on what action you think might be taken to promote more effective use of human engineering within the aircraft industry?"*

Dr. McFarland: "I would like to suggest several steps. Let us train men in the service laboratories and then have them placed in the larger manufacturing companies, perhaps also the smaller ones.

"The universities also should do more along this line. We do not have specific courses of study in this area, nor do the courses in the technical schools introduce enough material along the line of human engineering.

"Also, the human engineering groups do not always present data and material in a way that is intelligible. Having participated in this myself, I'm not criticizing others. Our work sometimes can be pointed up to a greater degree of intelligibility so that the engineer who isn't familiar with the subject will be able to use it without having to employ a staff of people necessarily trained in the biological and psychological sciences."

A. W. Reichel: "We'd be very happy to have human engineers in our organization, provided we had some assurance that their opinions and directions would agree with the other human engineers that would be on the mock-up board. But, perhaps the human engineer should start with the Military requirements people at the time the weapons systems are being discussed, when the fundamental parameters of these weapons systems are being laid down. Perhaps this is where the human engineer can play his most important role. From him, these requirements will be passed on to the airframe manufacturer and will be reflected in any equipment we may be supplying to the airframe manufacturer. We then can have our own human engineers who assist us in coordinating with the human engineer in the planning section."

Joseph G. Wohl: *(Human Engineering Section, ONR, USN):* "It seems, then, that in order to insure that it results in optimal equipment design, human engineering must take place on two levels: at the planning and military requirements level, as Mr. Reichel suggested, and also at the actual product-design level. However, we've gotten away from the basic point. The question is, how can we promote effective use of human engineering within the industry?"

J. Lederer: "Perhaps the human engineers should organize a campaign and show the aircraft engineers within industry just how they can help.

"Another point, courses in human engineering should be given by colleges and universities. I've been visiting colleges around the country and advocating such courses, but the replies I get are that the colleges will supply what industry demands and until industry demands human engineers, those courses are by-passed.

"The third point I'd like to mention . . . and this is in connection with Mr. Reichel's problem . . . is that an integration of thinking is required. You can't just go to one instrument and say it should be designed in such-and-such a way. The reason the SAE Committee was successful was that they got varying ideas from all segments of industry."

LCdr. Hoover: *"Dr. Orlansky, what do you think about Mr. Lederer's suggestion regarding the establishment of a sales campaign?"*

Dr. Orlansky: "As Mr. Reichel said, industry works for profit, and the human engineer, like any other engineer, should be able to pay his own way. In our own business, we have made a special point of demonstrating this, and it has increased our acceptance among engineers.

"Our systems are becoming more complex, and there is a definite need for greater attention to the human factor in these systems. The performance of the human operator can influence very markedly the effectiveness of such systems.

"First, then, it would seem helpful to publicize instances of effective human engineering. Everyone is aware of the importance of standardizing a cockpit. Another example is the importance of using shape-coded knobs to organize control functions; here, I am thinking of the wheel control knob which looks and feels like a wheel. These examples of effective human engineering have a pay-off in reducing accidents. In other words, demonstrate cases where good human engineering saves dollars and lives.

"Secondly, it is important to show that many human engineering facts exist right now. It also follows, of course, that there are some areas in which little is known at present. I believe the same situation exists in engineering.

"Third, I think we should train engineers in the field of human engineering. This probably should be done in some engineering schools and in some psychology schools. There should be more of both.

"Fourth, it is important to establish engineering standards which recognize the importance of human performance to the effective functioning of equipment. This should probably be done through various SAE Committees, wherever applicable. This means requiring not only operator safety but efficient performance of the system, at least in any system where humans have to make it work.

"Fifth, I think the most important thing we can do is to pay attention to requirements before we build any system. I suspect that many of the problems raised at this meeting developed because the requirements were not adequately surveyed before the contract was let. Therefore, the

gineer tends to be concerned with ether his machine will work and t with whether it can be used to complish a specific job. We need better technique of building up the quirements and then a way of easuring whether or not the equipent will satisfy the requirements. his, I think, is the user's rather an the builder's responsibility. We ve to be very explicit in knowing hat we are designing for."

r. Taylor: "Mr. Reichel hinted at mething that I think should be rought out a little more, and that's e feeling on his part that it would e difficult in all cases to trust the uman engineer. There probably are ery good reasons for that.

"Human engineering is very new nd there are no universal standards s to who is and who isn't a human ngineer, who is a good one, and who a bad one. One of the reasons that ngineers may be reluctant to take ne advice of the human engineer is hat when they have previously done o, the effort may have come to an nhappy conclusion. I have been in his field for nine years and I've seen ll kinds of recommendations made or all kinds of problems. In some inances the person who claimed to be human engineer gave a stone when ne engineer asked for a loaf.

"Sometimes the engineers have sked for assistance in a problem nd, instead of practical help, they ot basic research data which were ot interpretable in terms of the roblem. Another thing that has happened is that the human engineer, if rained as an academician, refuses to uess on the basis of insufficient inormation, and so he reports only hat more research is needed. Sometimes engineers have discovered that ne human engineers working in their elds pick out the most inconsequenial and unimportant details of a roblem to work on. Finally, engineers sometimes get recommendations rom the human engineers which how a complete lack of appreciation f the engineer's problems.

"Mr. Reichel also mentioned the ifficulty of having as many answers o his problems as there are human ngineers working on them. May I oint out that the fact that different uman engineers have different answers does not necessarily mean that ll of them are not correct. It is enirely possible to get four human ngineers to solve the same problem n four different, yet entirely satisactory, ways. That sort of thing appens in all engineering."

Dr. Grether: "Relative to the problem of what action to take to promote

(Continued on Page 42)

SKYWAYS

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YUMA—Yuma County Airport—*SPAIN FLYING SVCE:* Hangars, tie-dwn $1 nite; *UNION* 80-91; line svce 24 hrs, A&E; major and minor sing-eng, radio & arframe; wash, polish, paint, clean. Dealer: *PIPER, CESSNA, CONTINENTAL, GOODYEAR.* Eng, ignition prts. *AVIS,* taxi. Food 1/2 mi 24 hrs; lodging, swim pool adjacent arprt; pilot lnge, Gulf & Union crdt crds; food to go delivered to arcrft 45-min notice. Airport: 5 mi SSE; municipal & Air Force field; el 213; lat 32-39, long 114-36; no lndng fee; tower, unicom, teletype, weather, lights, rotating beacon; San Diego sect cht; 3 paved rnwys, longest 6505; obstr, poles N, P-line NE. Betty Tank Mgr, Tel 3-3111 & 3-4669. Airlines: BAL.

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MICHIGAN

LANSING—Capitol City Airport—*FRANCIS AVIATION:* Metal hngrs, $2.50 to $5 nite; no tie-dwn fee; *STANDARD* 80-91; line svce and A&E, 7.30 a.m. to 5.30 p.m.; major & minor sing & multi eng, radio; minor airframe, instru exchange; wash, polish, paint, interior. Dealer: *CONTINENTAL, LYCOMING, BEECHCRAFT, LEAR;* Continental eng prts. Taxi, limousine, *AVIS.* Pilot lnge, Standard crdt crds; food on arprt 8 a.m. to 8 p.m., food to go avail no notice; lodging, motel adjoining arprt, Lansing hotels 6 mi. Gerald C. Francis, owner; Tel. 4-1324. Airport: 6 mi E; el 858; lat 42-46, long 84-35; no lndng fee; adm. bldg, control twr, radio facil, teletype, weather, lights, beacon. 3 paved rnwys, longest 5000, 2 lighted; obstr: TV twr 1900 ft 11 mi E. Neal Brackstone Mgr, Tel 4-5437. Airlines: CAP.

MONTANA

BILLINGS—Billings Municipal Airport—*LYNCH FLYING SERVICE:* 1 lrge hngr, fees from $1.50 to $3.50; tie-dwn 75 cents nite; *UNION* 80-91-100-130; line svce 6 a.m. to 7.30 p.m.; A&E 8 a.m. to 5 p.m.; man on call nite; major maintenance facilities. Dealer: *CONTINENTAL;* Montana distributor *CESSNA;* wash, polish, paint, clean. Taxi, *HERTZ, AVIS.* Food on arprt 24 hrs, lodging Billings; Union, British-American, Mid-Continent, Utah crdt crds. Airport: 2.5 mi NW; el 3612; lat 45-48, long 108-32; no lndng fee; control tr, radio, weather, teletype, lights, beacon; Yellowstone sect cht; 4 rnwys, longest paved 5689. Dick Logan Mgr, Tel 3-3567. Airlines: DAL, NWA, WAL.

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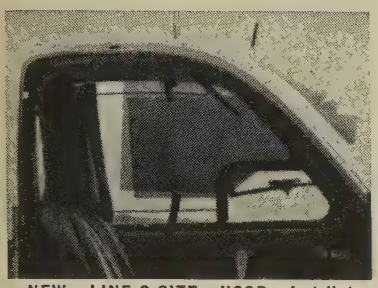

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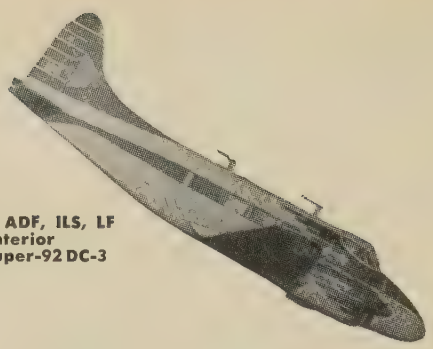

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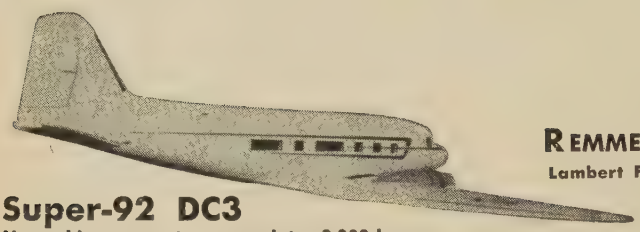

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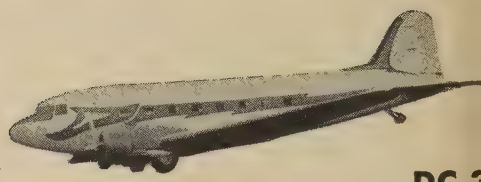

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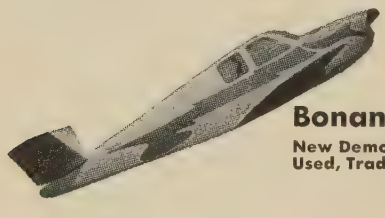

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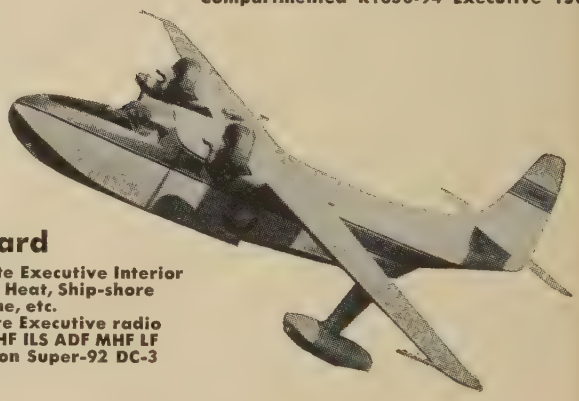

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Skyways Round Table

(Continued from Page 39)

more effective use of human engineering within the aircraft industry, I for one will admit that the dissemination of the data in the human engineering field has been very unsatisfactory. Much of it has been put out as Government reports and has gotten very little circulation. Quite often it doesn't get to the people who should see it. I'd like to go back and mention again this Human Engineering Guide that is now jointly being worked on by the Army-Navy-Air Force. To my mind, this is really the only helpful solution to this problem.

"In addition to the Guide, one other thing would help, and that is a Human Engineering Journal. Fligh Safety Foundation is now putting ou Human Engineering Bulletins, an they are a help and a good beginnin to this Journal idea which would b a clearing house of thinking. I should be a place to present desig solutions based upon research, an as such would give the engineer good deal of advice and guidance.

Dr. McFarland: "One thing tha would be helpful would be to set u symposiums in the different specia ties of the engineering sciences."

LCdr. Hoover: *"Dr. Van Court o The de Florez Company is here toda as an observer, and I think he ha something to add regarding indus try's use of human engineering."*

(Continued on Page 44)

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(Continued on Page 44)

CLASSIFIED ADVERTISING

(Continued from Page 43)

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Skyways Round Table

(Continued from Page 42)

Dr. S. W. Van Court *(Psychologist, The de Florez Co.)*: "Mr. Reichel mentioned the need for human engineering at the planning stages of equipment, presumably in government. He also cited how instrument manufacturers could utilize these services. I propose greater employment of human engineering by the airframe manufacturers who have the ultimate responsibility for getting equipment into airplanes. To my knowledge, a few companies have done this already. For example, Hughes Aircraft Company employs a human engineer full time on its projects. Douglas Aircraft Company has both consultants and about 12 human engineers on a sub-contract basis from Dunlap and Associates, General Electric, Institute for Research in Human Relations and The de Florez Company."

LCdr. Hoover: *"At this time, gentlemen, I'd like to sum up with the following points that were made during the discussion:*

1. *Design engineering is definitely ahead of human engineering. In other words, equipment and instrument design has gone ahead without systematic consideration of human requirements.*
2. *There is definitely a need for better organization of human engineering facilities so that there will be a more available source of these services to the manufacturers.*
3. *In order to keep personal opinion to a minimum, there is a need for more accurate and detailed information on human requirements for particular items of equipment.*
4. *There are human engineering sources available to industry and they should be utilized.*
5. *There should be a close working relationship between human engineers and the engineers who are working on the equipment.*
6. *The universities should offer more courses in human engineering, and industry must demand that such courses be given.*
7. *Industry should publicize those examples where human engineering has been a definite help.*

"These, then are a few of the points brought out during this discussion. I'd like to express my appreciation to you gentlemen for participating in the Round Table, and I'd also like to express the appreciation of the entire human engineering group to SKYWAYS for giving us this medium of 'getting the word out'." +++

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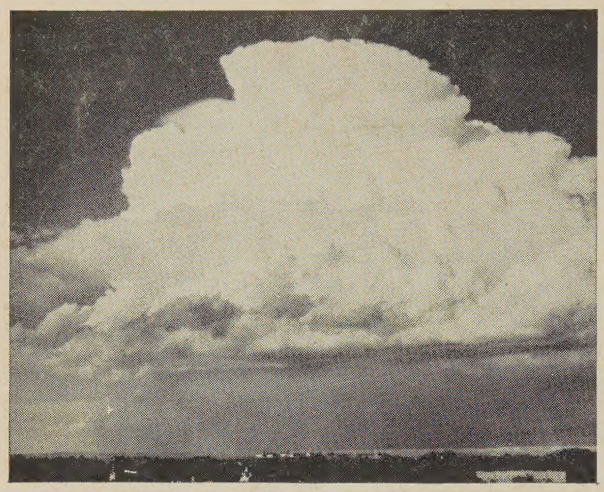
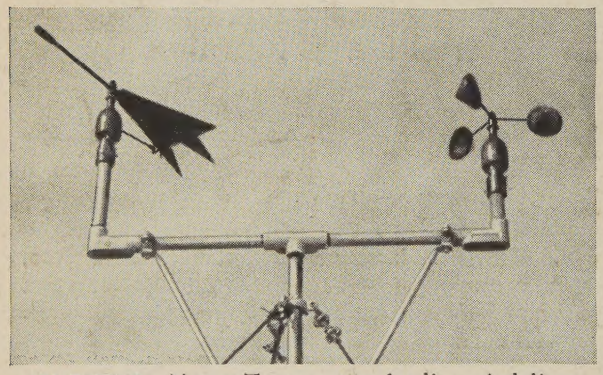
[These weather items prepared in consultation with the United States Weather Bureau]

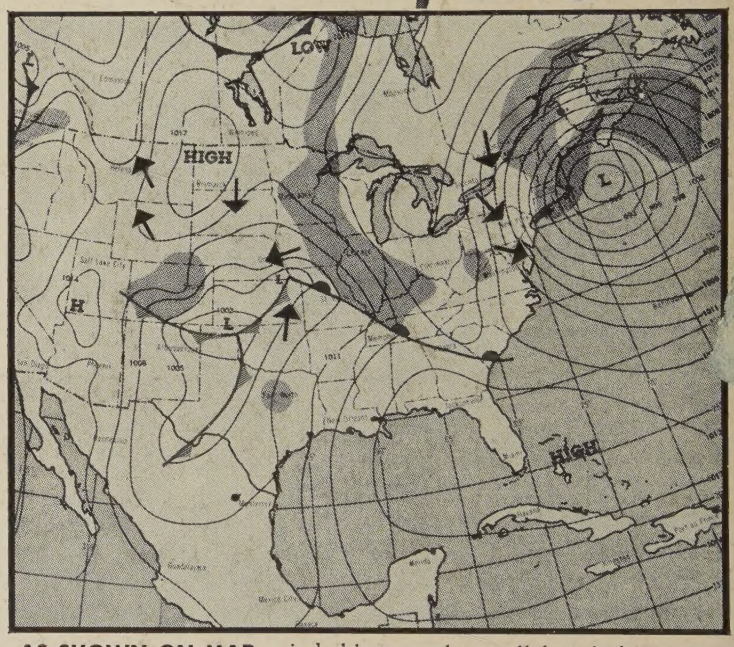


ALLOW EXTRA MARGIN of air speed when landing in the vicinity of thunderstorms because of sudden wind shifts and gusts. Rapid shifts often accompany the cold downdrafts just ahead of the storm.



REMEMBER—Airport Towers report landing wind direction in degrees magnetic, like runways. On weather reports, however, wind direction is always with reference to true north. Over 20° difference in some parts of U. S.

WINDS ALOFT usually differ greatly from surface winds. Check the U. S. Weather Bureau's Winds Aloft Analyses, issued 4 times daily and distributed on aviation teletypewriter circuits.



AS SHOWN ON MAP, winds blow nearly parallel to isobars—the closer the isobars, the stronger the winds. When facing the wind, high pressure lies to left and low pressure to right. (Northern Hemisphere)

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